Return to the Browser Screen

Service Manual

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MANUAL REVISION RECORD

DATE	REVISION	ECN NUMBER AND DESCRIPTION
August 2008	A	20082197 - Initial release of *Constellation*® Vision System Service Manual.

constellation VISION SYSTEM

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IMPORTANT NOTICE

Equipment improvement is an on-going process and, as such, changes may be made to the equipment after this manual is printed. Accordingly, Alcon makes no warranties, expressed or implied, that the information contained in this service manual is complete or accurate. It is understood that if this manual is used to perform service on the equipment by other than trained personnel, the user assumes all risks in the use of this manual.

In order to protect the goodwill associated with Alcon, and its products, maintain Alcon's standards, and provide its customers with a high quality of service, Alcon strongly recommends that all servicing of this equipment be performed by Alcon-trained service personnel. Such personnel receive in-depth, extensive training in the servicing of the equipment, including training in the diagnosis and correction of problems that may arise with the equipment. Any servicing of this equipment by persons other than Alcon-trained service personnel may expose those persons, subsequent users of this equipment, patients, and other third parties to significant risk of serious injury and/or death. Alcon will not assume responsibility for the effect of the repairs, damages, or personal injuries arising from repairs by any third party.

CAUTION

Federal law restricts this device to sale by or on the order of a physician.

WARNINGS AND CAUTIONS

Pay close attention to warnings and cautions in this manual. Warnings are written to protect individuals from bodily injury. Cautions are written to protect the instrument from damage.

UNIVERSAL PRECAUTIONS

Universal precautions shall be observed by all people who come in contact with the instrument and/or accessories to help prevent their exposure to blood-borne pathogens and/or other potentially infectious materials. In any circumstance, wherein the exact status of blood or body fluids/tissues encountered are unknown, it shall be uniformly considered potentially infectious and handled accordingly. This is in accordance with OSHA guidelines.

Comments or corrections concerning this manual should be addressed to:

Alcon Laboratories, Inc.
Technical Services Group
PO BOX 19587
Irvine, CA, USA 92623-9587

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SECTION ONE
GENERAL INFORMATION

Introduction

The *Constellation*® Vision System is a multifunctional surgical tool for use in anterior and posterior segment ophthalmic surgeries. The product's capabilities include driving a variety of handpieces that provide the ability to cut vitreous and tissues, emulsify the lens, illuminate the posterior segment of the eye, and apply diathermy to stop bleeding. Vacuum is used to remove ocular matter from the eye and is provided by connecting tubing from the handpiece to a port on the fluidics cassette. Irrigation/infusion capability is provided to replace fluid in the eye, and enters the eye directly via either an infusion cannula or flows through a handpiece. The graphical operator interface is menu driven. The operator provides inputs using the touchscreen panel, the remote control, voice commands, and the footswitch.

The *Constellation*® Vision System is a multi microprocessor-controlled ophthalmic surgical instrument with associated memory and input/output (I/O) circuitry. The system communicates with the user via its Front Panel display, with voice confirmations, and with tones. An automatic self-test is initiated each time the system power is turned on.

This test performs a variety of functions including the following:

- Tests the Central Processing Unit (CPU)
- Tests the RAM and ROM memory, and the I/O circuits
- Initializes the system

When the system successfully completes the self-test, it automatically goes into the Setup mode. If the system fails the self-test, an error message is displayed.

Figure 1-1 **The *Constellation*® Vision System - The *Constellation*® Vision System is a multifunctional surgical tool is used in anterior and posterior segment ophthalmic surgeries.**

About This Manual

This manual is divided into seven sections as follows:

Section One - General Information
This section gives a general description of the *Constellation*® Vision System features and components. Cautions and Warnings, specifications, icons used with the system, and labels are also included.

Section Two - Theory of Operation
This section gives a detailed description of how the *Constellation*® Vision System operates starting at the system level and working down to the PCB (Printed Circuit Board) level. Detailed block diagrams are provided at the end of this section.

Section Three - Parts Location and Disassembly
This section contains parts location diagrams along with field level disassembly procedures.

Section Four - Maintenance & Troubleshooting
This section contains system maintenace procedures and troubleshooting information.

Section Five - Schematics
This section contains system interconnect diagrams, fluidic diagrams, pneumatic diagrams, and cabling schematics.

Section Six - Parts Lists and Drawings
This section contains parts lists and exploded drawings for each major assembly.

Section Seven - Additional Information
This section contains information on accessories or optional equipment that may require service.

Reference Documents

Although this manual provides the necessary information for maintaining optimum performance of the *Constellation*® Vision System, it does not contain all of the operating procedures or functional descriptions contained in the operator's manual. In addition, the Warnings and Cautions in the operator's manual also apply for this service manual. The operator's manual supplements information provided in this manual, and should be available on-site with the system.

If you have any questions or require additional information, please contact your local service representative or the Technical Services Department at:

Alcon Laboratories
15800 Alton Parkway
Irvine, CA 92618
(949) 753-1393
(800) 832-7827

If you are located outside the United States, please contact your local authorized Alcon distributor.

CAUTION

Federal Law restricts this device to sale by or on the order of a physician.

Receiving Inspection

The system was inspected mechanically and electrically prior to shipment. If the shipping container appears damaged, ask that the carrier's agent be present when the system is unpacked. The system should be inspected for external damage (i.e. scratches, dents, or broken parts). If damage is discovered or if the system fails any of the functional tests notify the carrier and an Alcon representative. Retain the shipping container and packing material for the carrier's inspection. As necessary, file a claim with the carrier or, if insured separately, with the insurance company.

Table 1-1 *CONSTELLATION*® VISION SYSTEM SPECIFICATIONS

CONSOLE

DIMENSIONS:

Tabletop:	Height:	63.5 cm (25.0 inches)
	Width:	53.3 cm (21.0 inches)
	Depth:	57.2 cm (22.5 inches)
Base:	Height:	160.0 cm (63.0 inches)
	Width:	76.2 cm (30.0 inches)
	Depth:	77.5 cm (30.5 inches)
WEIGHT:	Tabletop:	61.2 kg (135 pounds)
	Base:	72.6 kg (160 pounds)

Note: If a base other than the optional Alcon base is used, it must be able to hold up to 250 pounds.

ENVIRONMENTAL LIMITATIONS:

	Operating	Non-Operating
Altitude:	-125 to 2000 m (-410 to 6562 feet)	-125 to 3000 m (-410 to 9843 feet)
Temperature:	10° C to 35° C (50° F to 95° F)	-10 to 55°C (14° F to 131° F)
Relative Humidity:	10% to 95% without condensation	10% to 95% without condensation

ELECTRICAL REQUIREMENTS: The console accepts the following ranges or input commercial power voltages and frequencies and meets the leakage currents specified in IEC 60601-1. Protection against electrical shock is Class I.

100-120 Vac 50/60 Hz 12 A max.
220-240 Vac 50/60 Hz 6 A max.

FOOTSWITCH

DIMENSIONS:
Height: 14.0 cm (5.50 inches)
Width: 22.9 cm (9.00 inches)
Depth: 43.2 cm (17.0 inches)

WEIGHT: 5.4 kg (12 pounds)

ENVIRONMENTAL: The footswitch construction is water tight in compliance with IEC 60601-1 and IEC 60601-2-2, subclause 44.6 aa.

ELECTRICAL: The footswitch is connected to the console via electrical cable. All power and communications enter/exit the footswitch from this cable.

PERFORMANCE SPECIFICATIONS

PRESSURIZED INFUSION/IRRIGATION @SEA LEVEL:

Range:	0 to 120 mmHg
Accuracy:	±(2% of setpoint +5 mmHg)
Flow Rate:	0 - 20 cc/min. for infusion (20 Ga) 0 - 60 cc/min. for irrigation
Setpoint Transient:	500 ms maximum

IOP CONTROLLED INFUSION:

Setpoint Range:	0-120 mmHg
Repeatability[1]:	± 2 mmHg[2]
Setpoint Response Time:	<500 ms (20 Ga)
Transient Disturbance Response Time:	<500 ms[3]
Flow Range:	0-20 cc/min

[1] BSS Dual chamber mode.
[2] BSS medium, 20 gauge high flow Cannula, steady state condition at rated flow range
[3] Transient condition from no flow state to 10cc/min

ASPIRATION/SUCTION @SEA LEVEL:

Standard & Reduced Pressure Range:	0-650 mmHg Vacuum
Minimal Pressure Range:	0-600 mmHg Vacuum
Pressure Accuracy:	±(2% of Setpoint +5 mmHg)
Flow Range:	
Posterior Modalities:	0-20 cc/min
Anterior Modalities:	0-60 cc/min
Transient Response Time (Standard Pressure Range):	From 0 to -400 mmHg @0 cc/min 10-90% Rise Time:300 msec max 90-10% Fall Time: 300 msec max

VACUUM @ SEA LEVEL:

Vitrectomy:	0 to 650 mmHg
Fragmentation:	0 to 650 mmHg
Extrusion:	0 to 650 mmHg
Extraction:	0 to 650 mmHg
Irrigation/Aspiration:	0 to 650 mmHg
Phacoemulsification:	0 to 650 mmHg

LOW PRESSURE AIR SOURCE (LPAS) @SEA LEVEL:

Pressure Range:	0 – 120 mmHg at rated flow
Pressure Accuracy:	±3% of setpoint +3 mmHg
Flow Rate:	1.2 slpm minimum at 120 mmHg

VITRECTOMY:

Submodes:	3D, Momentary, PropVac, VitWet
Cut Rate:	
UltraVit™ 5000 Probe:	100 to 5000 cpm
UltraVit™ 2500 Probe:	100 to 2500 cpm

Table 1-1 *CONSTELLATION*® VISION SYSTEM SPECIFICATIONS. . . continued

PERFORMANCE SPECIFICATIONS...continued

DIATHERMY:
- Frequency: 1.5 Mhz ± 10%.
- Waveshape: Sinusoidal
- Output power: 10 Watts maximum at 100% setting with 75 ± 10% ohm non-inductive load
- Power range: 0 - 100% of maximum output power

ILLUMINATION:
- Light Output through 20GA Fiber Probe: 0-200 hrs: 16 ± 6 lumens at 115% set point [1]; 201-400 hrs:16 ± 6 lumens at 115% set point [1]
- Light Output through 23GA Fiber Probe: 0-200 hrs: 23 ± 13 lumens at 115% set point [1]; 201-400 hrs: 23 ± 13 lumens at 115% set point [1]
- Light Output through 25GA Fiber Probe: 0-200 hrs: 18 ± 8 lumens at 115% set point [1]; 201-400 hrs: 18 ± 8 lumens at 115% set point [1]

[1] Based on a representative nominal UFR fiber.

FRAGMENTATION:
- Submodes: Linear, Fixed, Momentary
- Tip Stroke @ 100%: 3.1 ± 0.5 mils at 100% power
- Resonant Frequency: 39.0 ± 1.9 KHz
- Pulse Rate Range: 0 – 100 pps

SCISSORS:
- Submodes: Proportional, Multi-Cut
- Proportional Pressure: 0-50 psi @sea level
- Multi Cut Rate: single cut to 450 cpm

PROPORTIONAL AND CONTINUOUS REFLUX @SEA LEVEL:
- Pressure Range: 0 to 120 mmHg
- Pressure Accuracy: ±(2% of Setpoint +5 mmHg)

MICRO REFLUX:
- Pressure Range: 100 ± 50 mmHg[1]
- Volume: 15 ± 10 µL[1]

[1] measured with unoccluded 20 Ga *UltraVit*™ probe and aspiration tubing

VISCOUS FLUID CONTROL:
- Submodes: Inject, Extract
- Injection Pressure: 0 to 551.6 KPascal (0 to 80 psi) 0 to 482.7 KPascal @ Reduced (0 to 70 psi)
- Extract Vacuum at Sea Level: 0 to 650 mmHg

AUTO-GAS FILLING (AGF):
- Maximum Gas Pressure: 10 psig
- Fill Purity: 97.1% gas concentration following 3 purges & 1 fill

AUTO-STOPCOCK:
- Response Time: 0.5 seconds minimum
- Pressure (Liquid): 0-120 mmHg
- Rated Flow (Liquid): 20 cc/min
- Pressure (LPAS): 0-120 mmHg
- Rated Flow (LPAS): 1.2 slpm

PHACOEMULSIFICATION:
- Submodes: Burst, Pulsed, Continuous
- Tip Stroke @ 100%: 3.5 ± 0.5 mils
- Resonant Frequency: 34khz – 42Khz ± 10%.
- Pulse Rate Range: 0-100 pulses per second
- Burst Length: 2.5 sec – user adjustable
- Burst Pulse durations: 5 ms to 500 ms

ANTERIOR VITRECTOMY:
- Submodes: Wet, Dry
- Cut Rate: 0 to probe maximum

LASER (optional):
- Treatment beam:
  - Class: IV
  - Power: 30 mW to 2 W (maximum)
  - Wavelength: 532 nm
- Aiming beam:
  - Class: II
  - Power: less than 1 mW
  - Wavelength: 635 nm ± 5 nm

DOCTOR MEMORIES:
- Storage Capacity: No hard limit; advisory displayed when less than 15% of disk space is available.

TIMER:
- Range: 0 to 99:99:99
- Resolution: 1 s

TONE VOLUMES @ 1 Meter:
- Errors/Faults/Invalid Key: 40 to 65 dB, short tones
- Diathermy: 40 to 65 dB, continuous tone
- Advisory/Timer Expire/Elev Infusion: 0 to 65 dB, short tones
- Frag/Phaco/Vacuum: 0 to 65 dB, continuous tone
- Valid Key: Factory set and not adjustable
- Volume Accuracy: 6 dB

VOICE CONFIRMATION: 0 to 65 dB

REMOTE CONTROL:
- Method: Infrared
- Channels: 4

Table 1-2 TERMS AND ABBREVIATIONS

Term or Abbreviation	Description
ACMI connector	The type of connector used on fiber optic probes.
AGF	Auto-Gas Filling
BSS PLUS®	Sterile intraocular irrigating solution enriched with bicarbonate, dextrose, and glutathione.
CE	A mandatory conformity mark on many products placed on the single market in the European Economic Area (EEA)
cmH_2O	Centimeters of water
cpm	Cuts Per Minute
CSA	Mark indicate that a product, process or service has been tested to a Canadian or U.S. standard and it meets the requirements of an applicable CSA standard or another recognized document used as a basis for certification.
Detent	A discrete footpedal position at which more force is required to depress the footpedal to the next position.
Diathermy	The production of heat in body tissues by electric current for therapeutic purposes.
Extrusion	A mode where vacuum is available to remove fluid/matter.
F/AX	Fluid Air Exchange
Frag	Fragmentation
GA	Gauge
Global Function	A function whose status and controls are independent of the current footpedal position and surgery mode.
I/A	Irrigation/Aspiration
I/O	Input/Output
IOP	Intraocular Pressure
IEC	International Electromechanical Commission

Term or Abbreviation	Description
ISO	International Standards Organization
IV	Intravenous
LCD	Liquid Crystal Display
mmHg	Millimeter of Mercury. A unit of vacuum.
Monolith	System configuration in which the *Constellation*® tabletop and base are paired together.
N/A	Not Applicable
PEL	Patient Eye Level. A difference in height between the cassette and the patient eye level.
PIN	Personal Identification Number
psi	Pressure per Square Inch. A unit of pressure.
pps	Pulses Per Second
RS-232	A standard for serial binary data signals commonly used in computer serial ports.
slpm	Standard Liters Per Minute
Type BF	A classification for devices that have conductive contact with the patient, or have applied parts that are fixed in medium or long term contact with the patient
U/S	Ultrasound
USB	Universal Serial Bus
VFC	Viscous Fluid Control
VGA	Video Graphics Array
Vit	Vitrectomy. Extraction of the vitreous from the vitreous cavity.

Figure 1-2 ICONS USED WITH THE *CONSTELLATION*® VISION SYSTEM


Extrusion


Forceps


Fragmentation


Irrigation/ Aspiration


Laser


Phaco


Scissors


Viscous Fluid Control (VFC)


Vitrectomy


Expand Window

Help Video


Modify


Power


Save

AC ◀ AC In

AC ▶ AC Out


Aiming Beam


Air Pressure Input


Suto Gas Filling (AGF)


Alternating Current


CE mark to RTTE directive

CE mark to MD directive


CSA Mark in accordance to CSA C22.2 No. 601.1 and UL 60601-1 (LR 103168) IEC 60601-1-2, IEC 60601-2-2, & IEC 60601-2-22


Coagulation Connector


Connection Indicator


Dangerous Voltage


Dr. Filter


Eject


Equipotentiality


Footswitch


Forceps


Hot


Illuminator


I/O Data


Key Switch


Laser Connection

Laser Emergency Stop Switch


Laser Port 1


Tethered Laser


Manufacture Date


Multi-Function Port


Network Connection

Non-ionizing Radiation

Off

On

Consult Operator's Manual, or System Error, or Advisory

Opens Operator's Manual

Ready

Remote Door Lamp Laser Status

Remote Interlock

Scissors Connector

Serial In/Out

Standby State

System Fault

System Information

Type BF Equipment

U/S Handpiece Connecor

USB Connector

Figure 1-2 ICONS USED WITH THE *CONSTELLATION*® VISION SYSTEM. . . continued

Use appropriate
take-back system

Video Recorder
Control

Viscous
Fluid Control
Connector

VGA Out

Video In

Video Out

Vitreous Cutter
Connection

constellation VISION SYSTEM

constellation® VISION SYSTEM

DANGER: RISK OF EXPLOSION IF USED IN THE PRESENCE OF FLAMMABLE ANESTHETICS.

DANGER: RISQUE D'EXPLOSION. NE PAS EMPLOYER EN PRESENCE D'ANESTHESIQUES INFLAMMABLES.

CAUTION: GROUNDING RELIABILITY CAN ONLY BE ACHIEVED WHEN EQUIPMENT IS CONNECTED TO AN EQUIVALENT RECEPTACLE MARKED HOSPITAL GRADE.

CAUTION: RISK OF BURNS AND FIRE - DO NOT USE NEAR CONDUCTIVE MATERIALS. RENEW ELECTRODE CABLES UPON EVIDENCE OF DETERIORATION.

FCC ID: VMC212-1
IC: 7345A-2121

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Contains:
FCC ID: VMC212WIFI
IC: 7345A-212WIFI

OUTPUT	DIATHERMY
POWER (W)	10
IMPEDANCE (Ω)	75
FREQUENCY (MHz)	1.5

CAUTION

BF

100-120V 50/60 Hz 12A
MEDICAL/ELECTRICAL EQUIPMENT CLASSIFIED LR 103168
C SP US
UL60601-1/CAN CSA C22.2 NO 601.1
220-240V 50/60 Hz 6A
CE 0123

Alcon®
ALCON LABORATORIES, INC.
6201 SOUTH FREEWAY
FORT WORTH, TX 76134-2099 USA
MADE IN USA

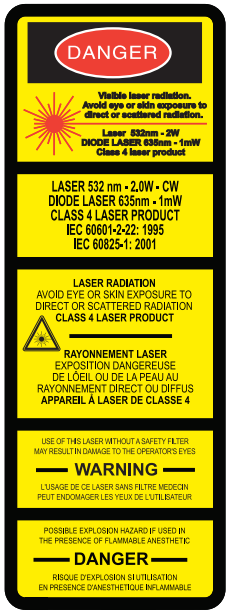
For applicable patents, please see the ABOUT screen on the monitor during operation.

WARNING
STORE TRAY PRIOR TO TRANSPORTATION

212-3019-001 REV P0

58-120 Psi
400-825 kPa

A G F
15-30 Psi
103-107 kPa



Labels for gas containers

USA - THIS SYSTEM CONFORMS TO ALL APPLICABLE STANDARDS OF THE RADIATION CONTROL FOR HEALTH AND SAFETY ACT OF 1988. COMPLIES WITH 21 CFR 1040.10 AND 1040.11 EXCEPT FOR DEVIATIONS PURSUANT TO LASER NOTICE NO. 50 DATED JULY 26, 2001.

Figure 1-3 LABELING ON *CONSTELLATION*® VISION SYSTEM

Figure 1-4 The Startup Screen

Figure 1-5 The Main Screen

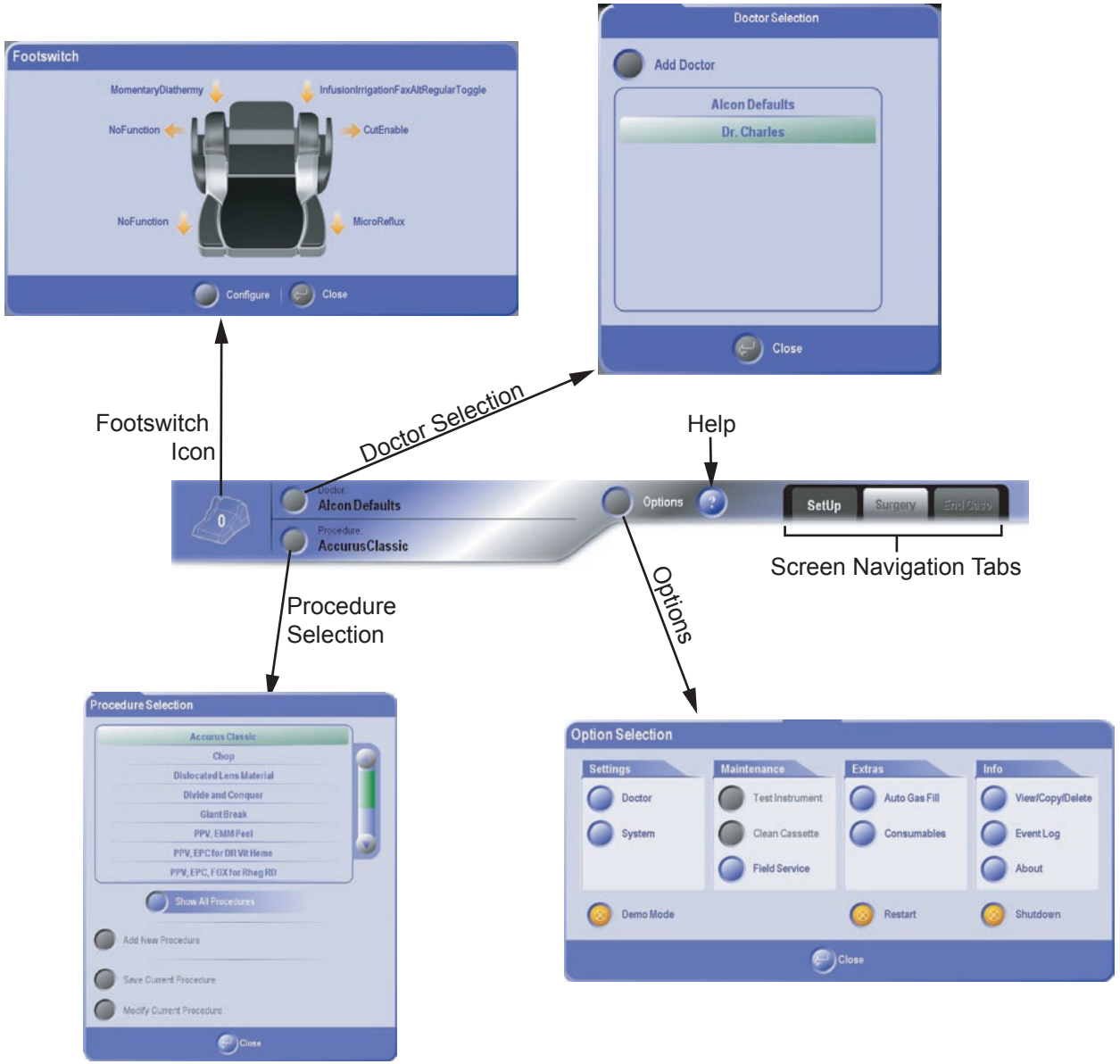


Figure 1-6 The Menu Bar

Figure 1-7 The Procedure Modify Screen (Menu Bar/Procedure button/Modify Procedure)

Figure 1-8 Doctor Settings Popup - General Tab (Options/Doctor Settings/General tab)

Figure 1-9 Doctor Settings Popup - Surgery / Inf / Irr Tab (Options/Doctor Settings/Surgery/Inf/Irr tab)

Figure 1-10 Doctor Settings Popup - Surgery / Reflux Tab (Options/Doctor Settings/Surgery/Reflux tab)

Figure 1-11 Doctor Settings Popup - Surgery / General Tab (Options/Doctor Settings/Surgery/General tab)

Figure 1-12 Doctor Settings - Footswitch Buttons Screen (Options/Doctor Settings/Footswitch/Buttons tab)

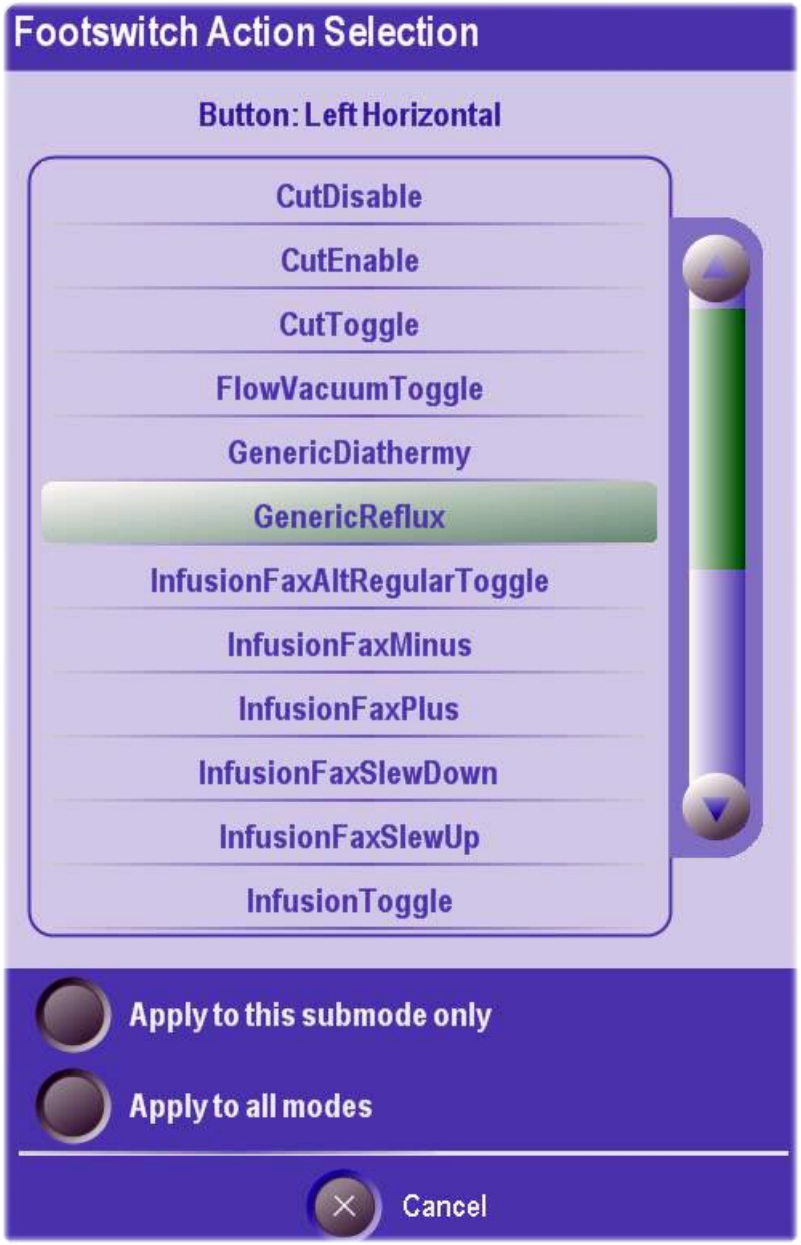


Figure 1-13 Footswitch Action Selection Popup

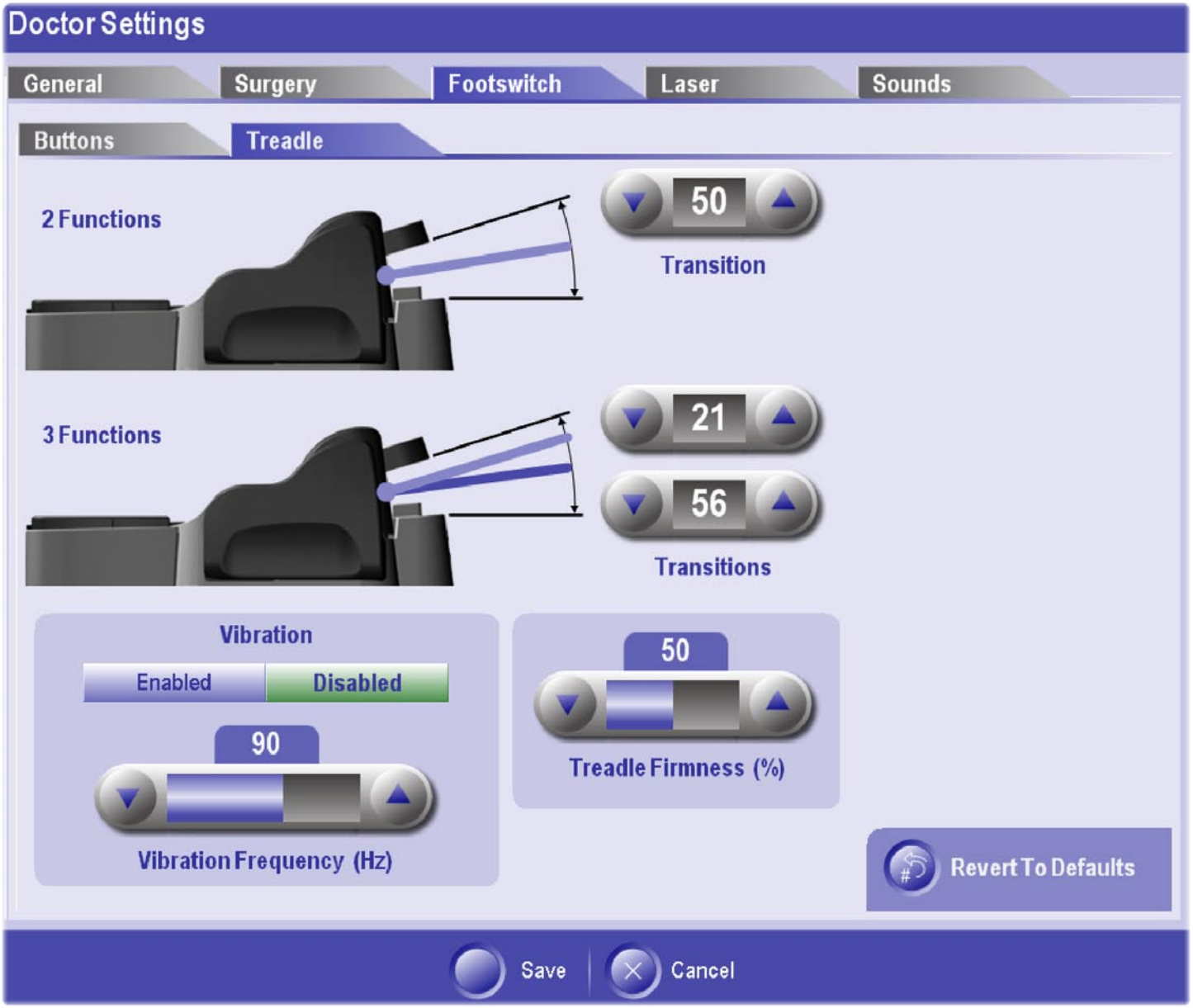


Figure 1-14 Doctor Settings - Footswitch Treadle Screen (Options/Doctor Settings/Footswitch/Treadle tab)

Figure 1-15 Doctor Settings - Laser Screen (Options/Doctor Settings/Laser tab)

Figure 1-16 Doctor Settings - Sound Screen (Options/Doctor Settings/Sound tab)

Figure 1-17 System Settings - Settings Screen (Options/System Settings/Settings tab)

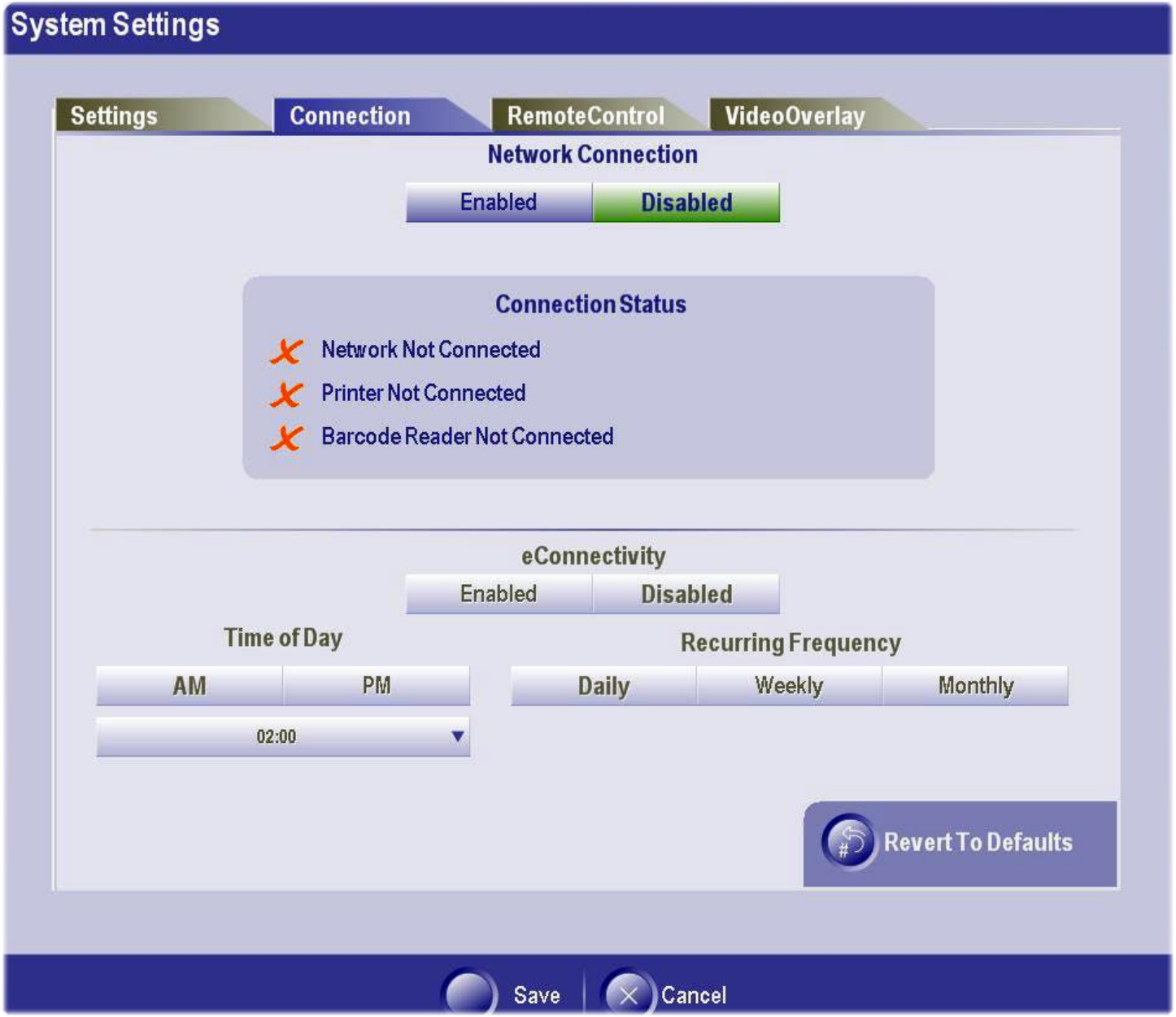


Figure 1-18 System Settings - Connection Screen (Options/System Settings/Connection tab)

Figure 1-19 System Settings - Remote Control Screen (Options/System Settings/Remote Control tab)

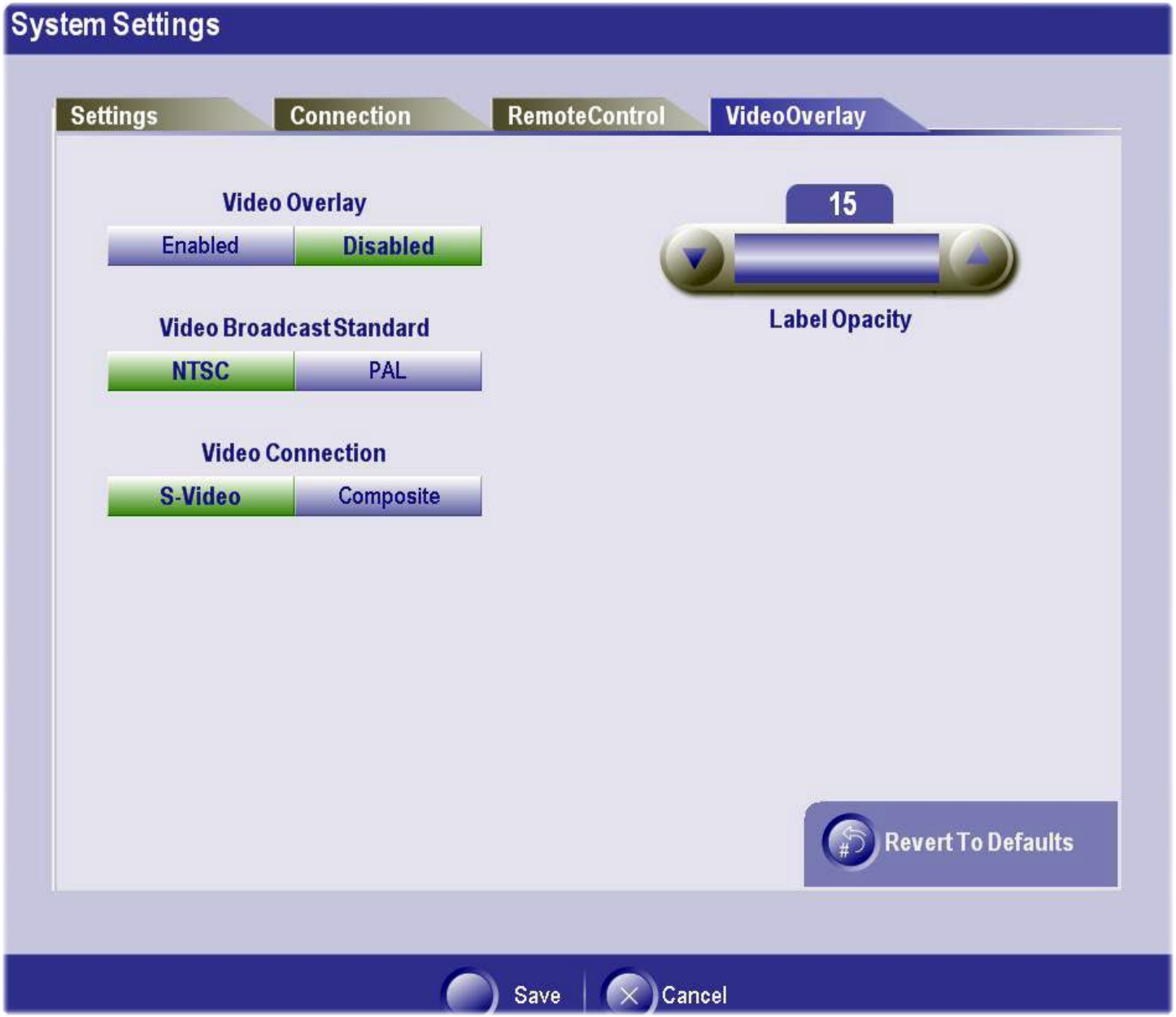


Figure 1-20 System Settings - VideOverlay Screen (Options/System Settings/VideoOverlay tab)

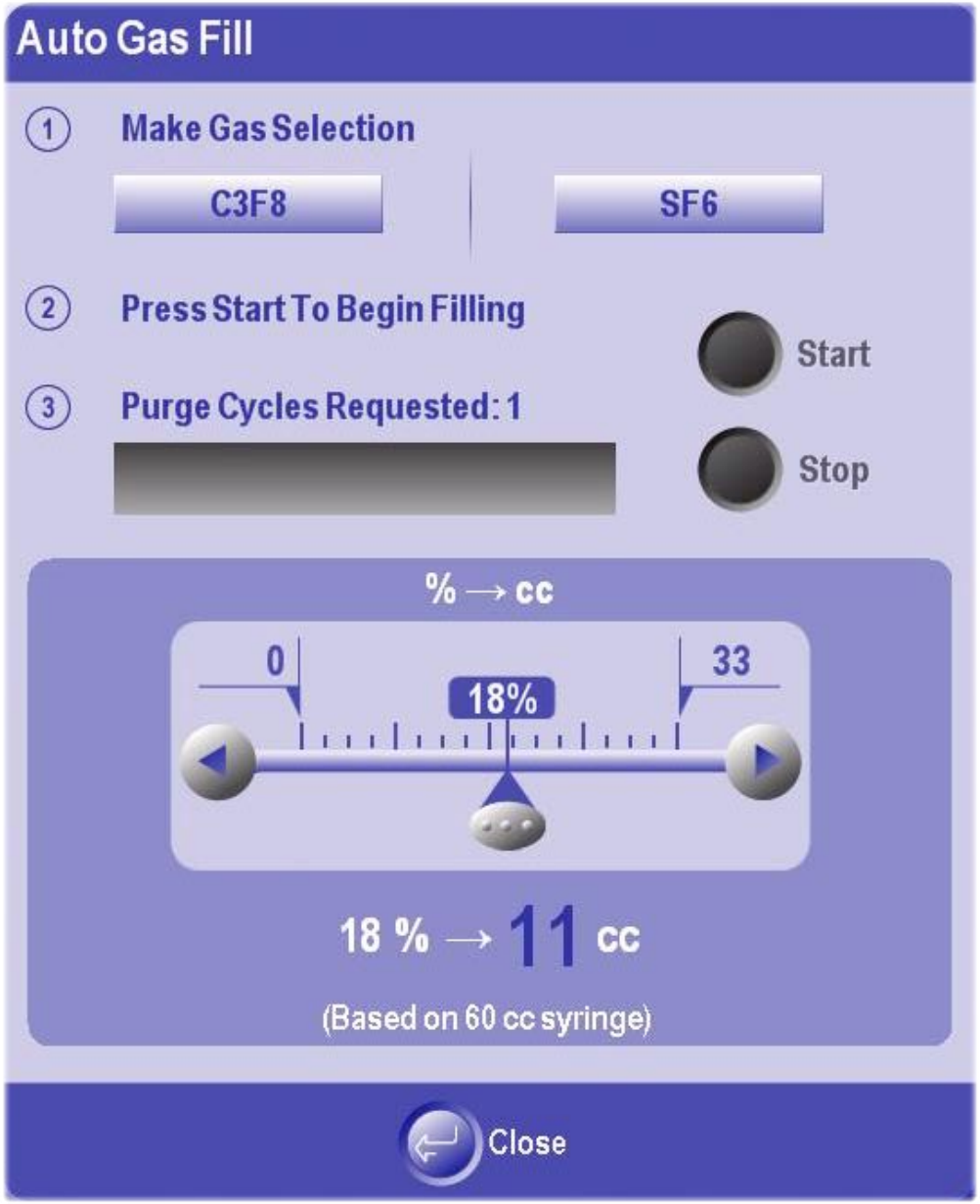


Figure 1-21 Auto Gas Fill Popup (Options\Settings-System\Extras\Auto Gas Fill)

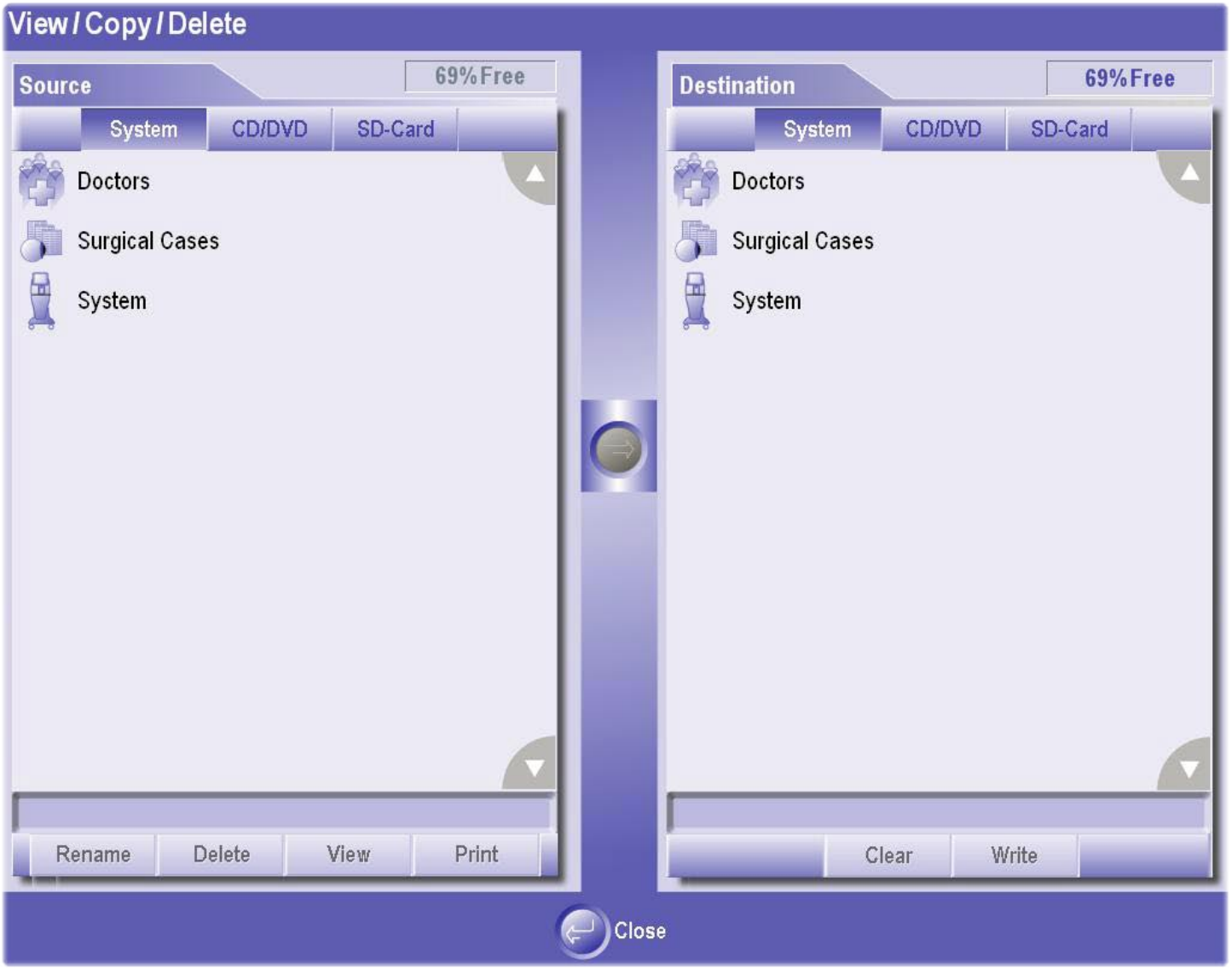


Figure 1-22 View / Copy / Delete Screen (Options\Settings-System\Info)

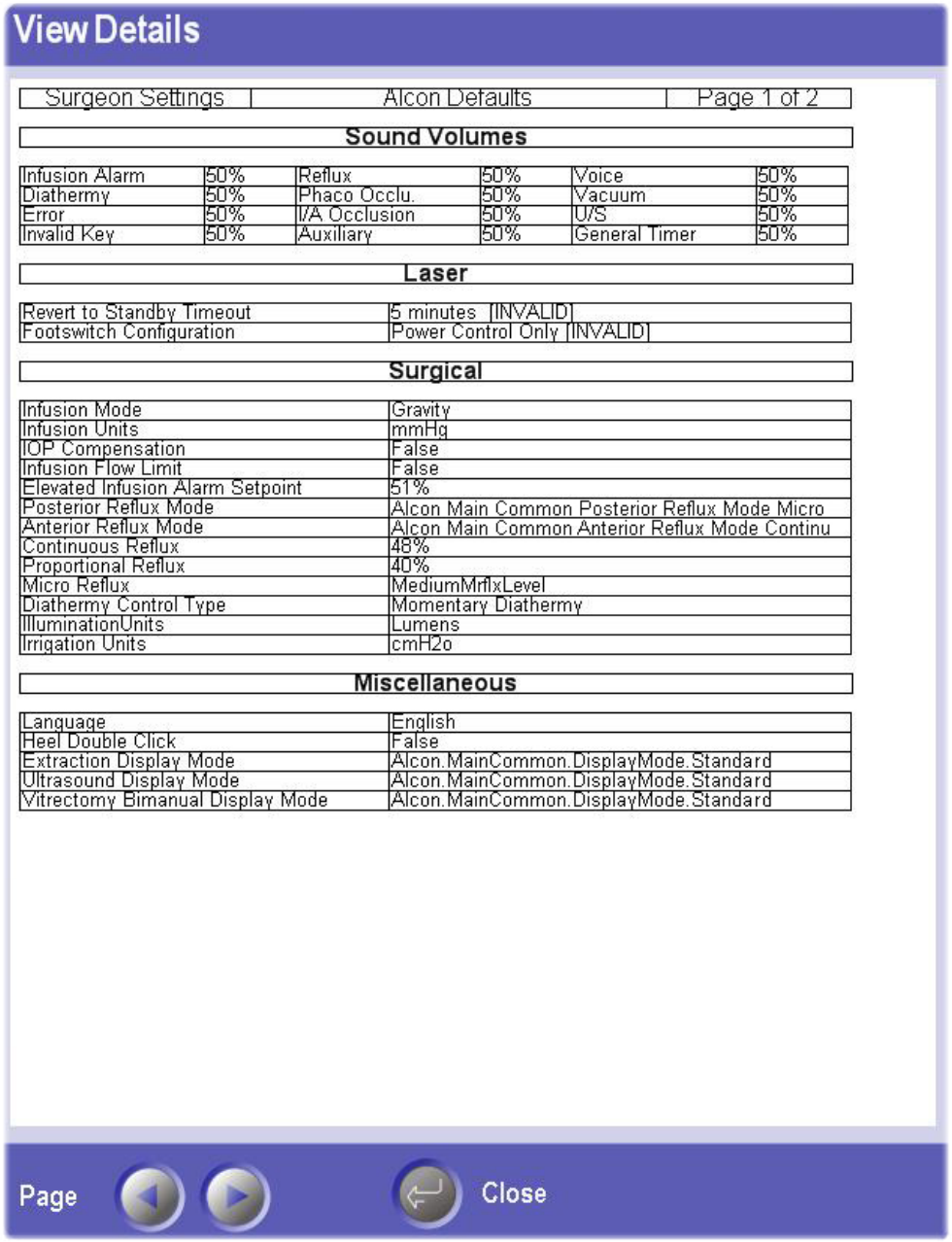


Figure 1-23 Sample View of a Doctor Settings Report

Figure 1-24 Event Log (Options\Settings-System\Info)

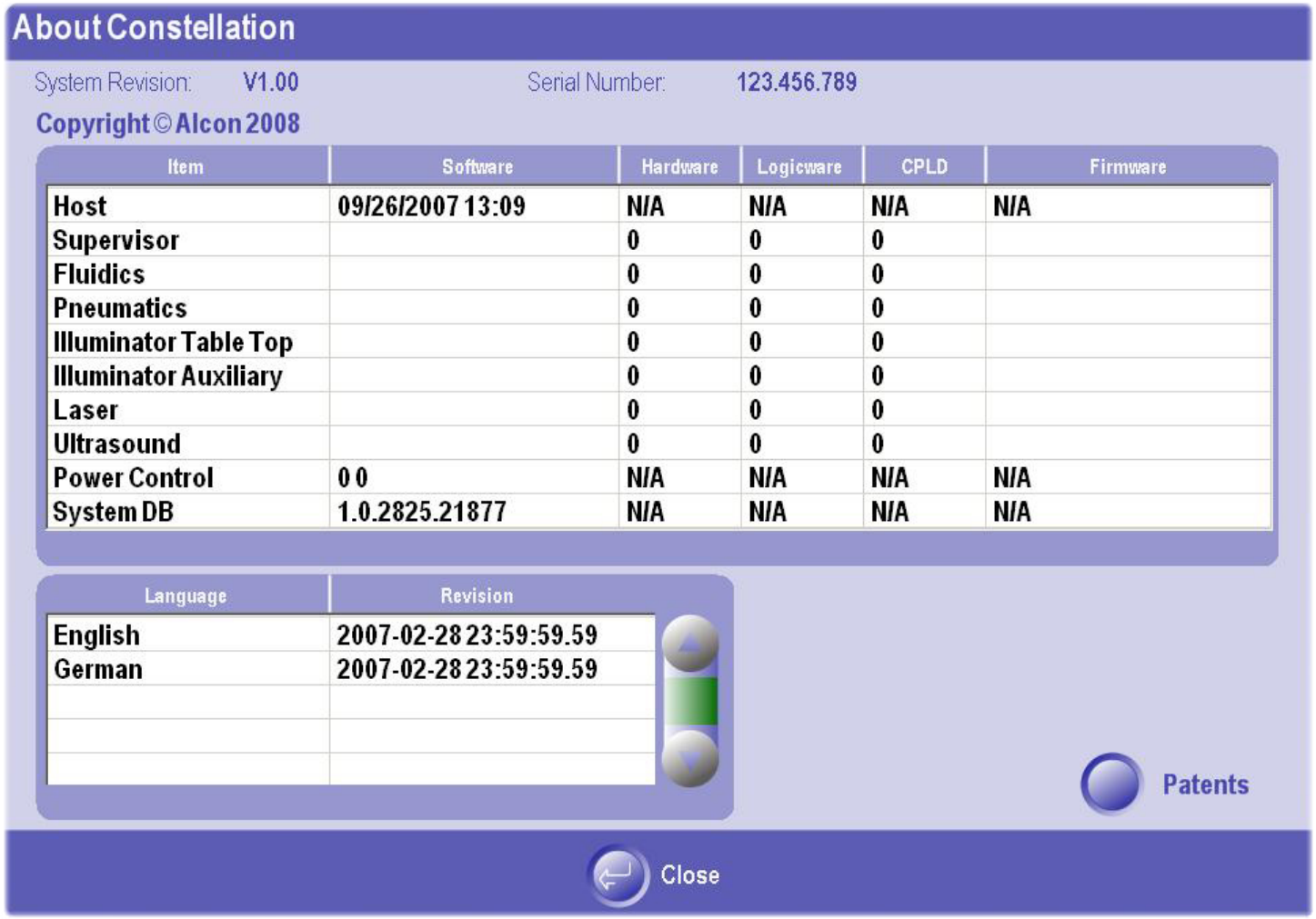


Figure 1-25 About Constellation (Options\Settings-System\Info)

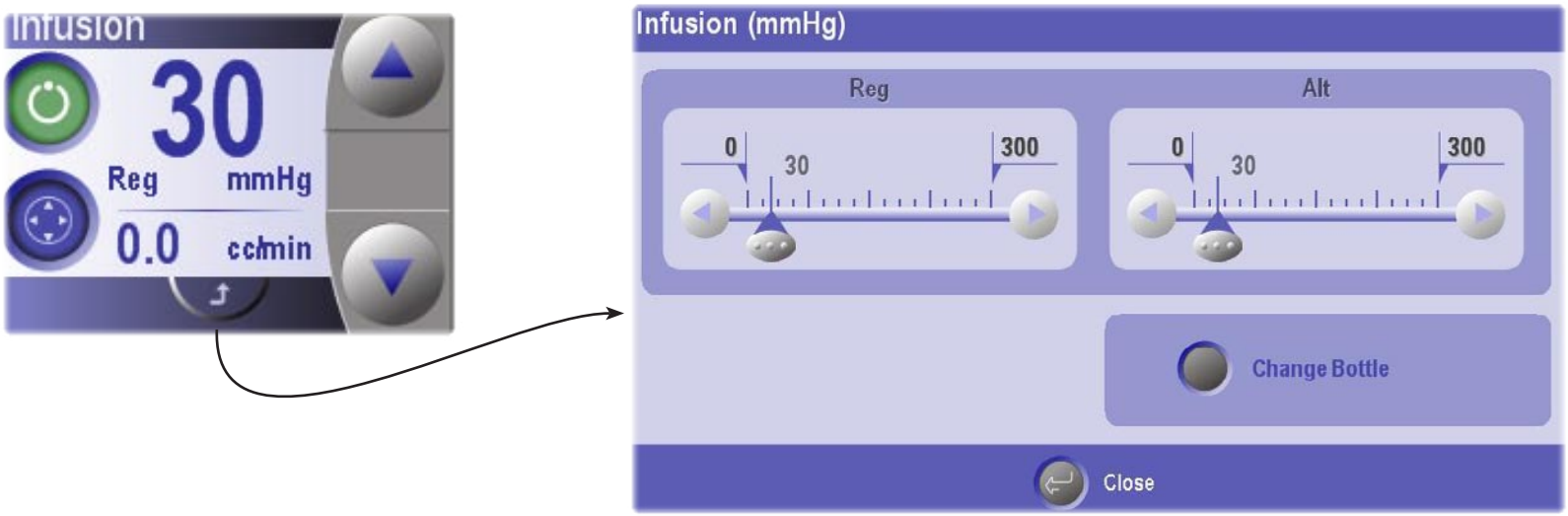


Figure 1-26 Infusion Global Control and More Information Popup

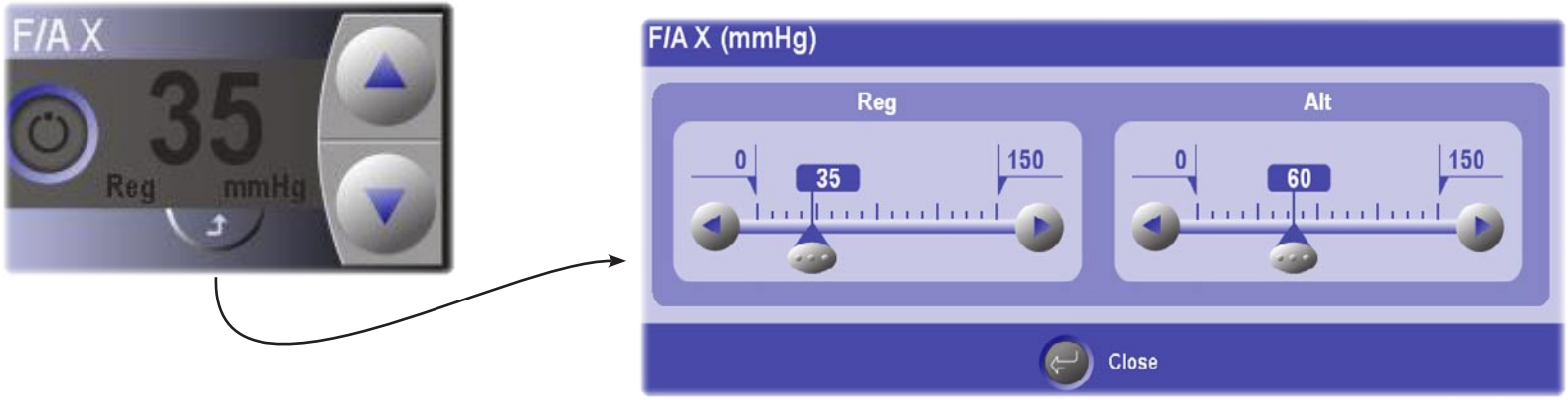


Figure 1-27 F/AX Global Control and More Information Popup

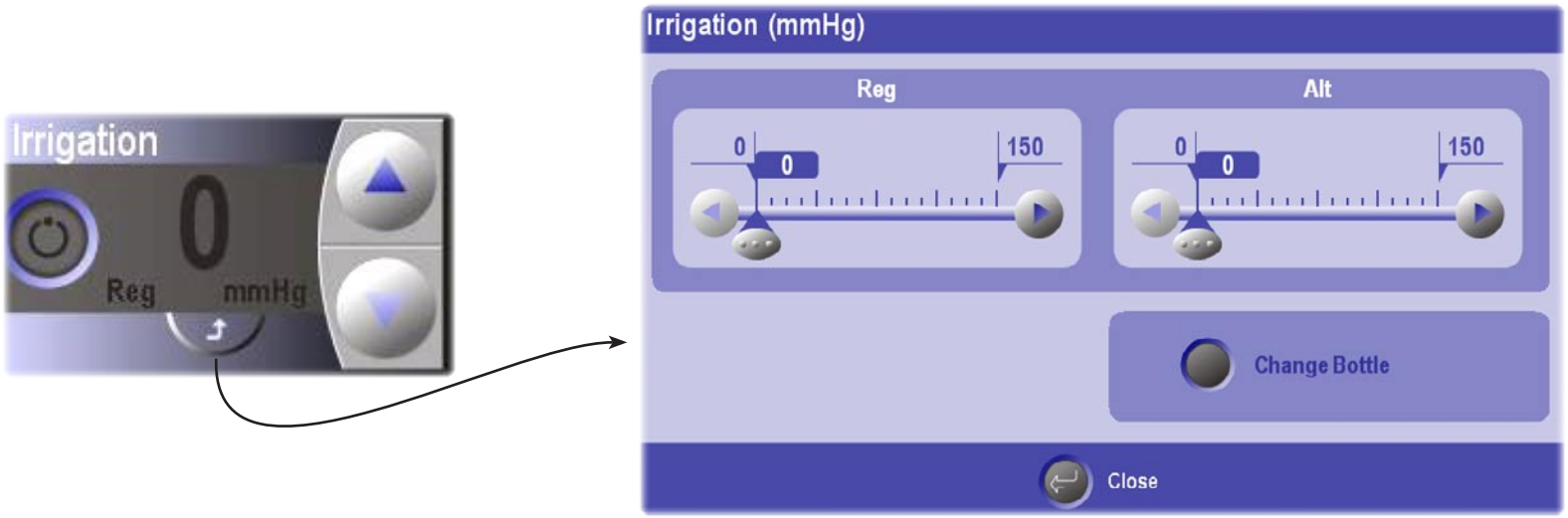


Figure 1-28 Irrigation Global Control and More Information Popup

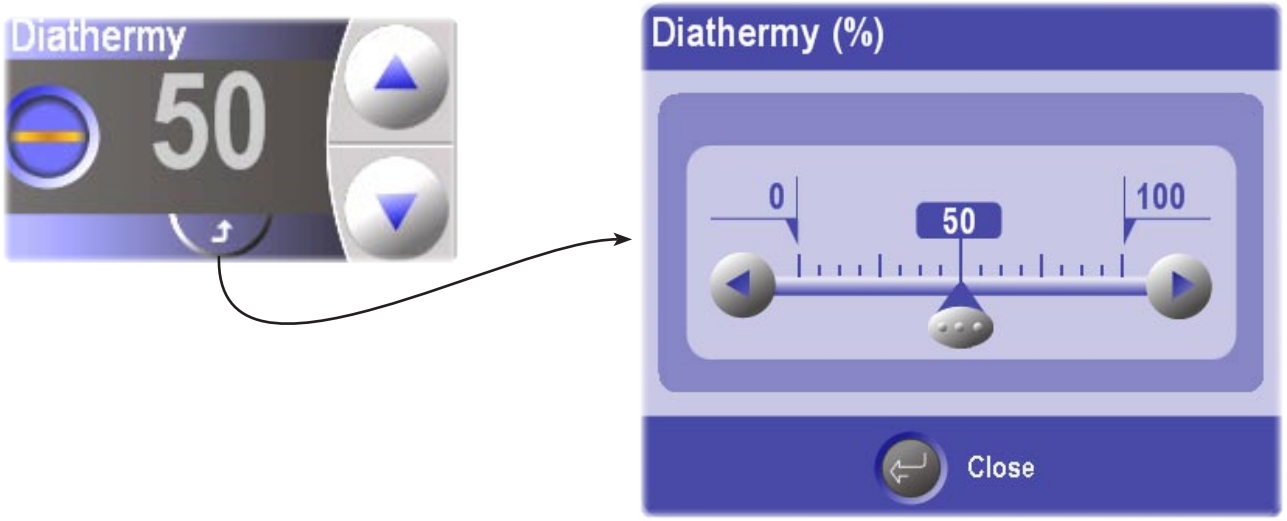


Figure 1-29 Diathermy Global Control and More Information Popup

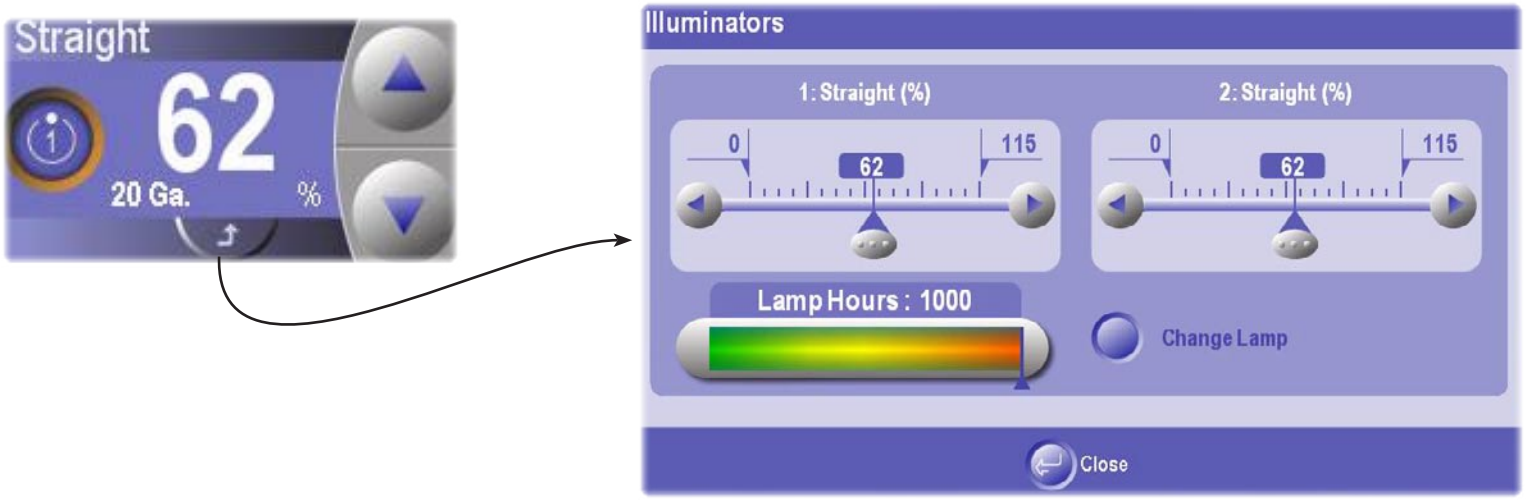


Figure 1-30 Illuminator Global Control and More Information Popup

Figure 1-31 The Setup Screen

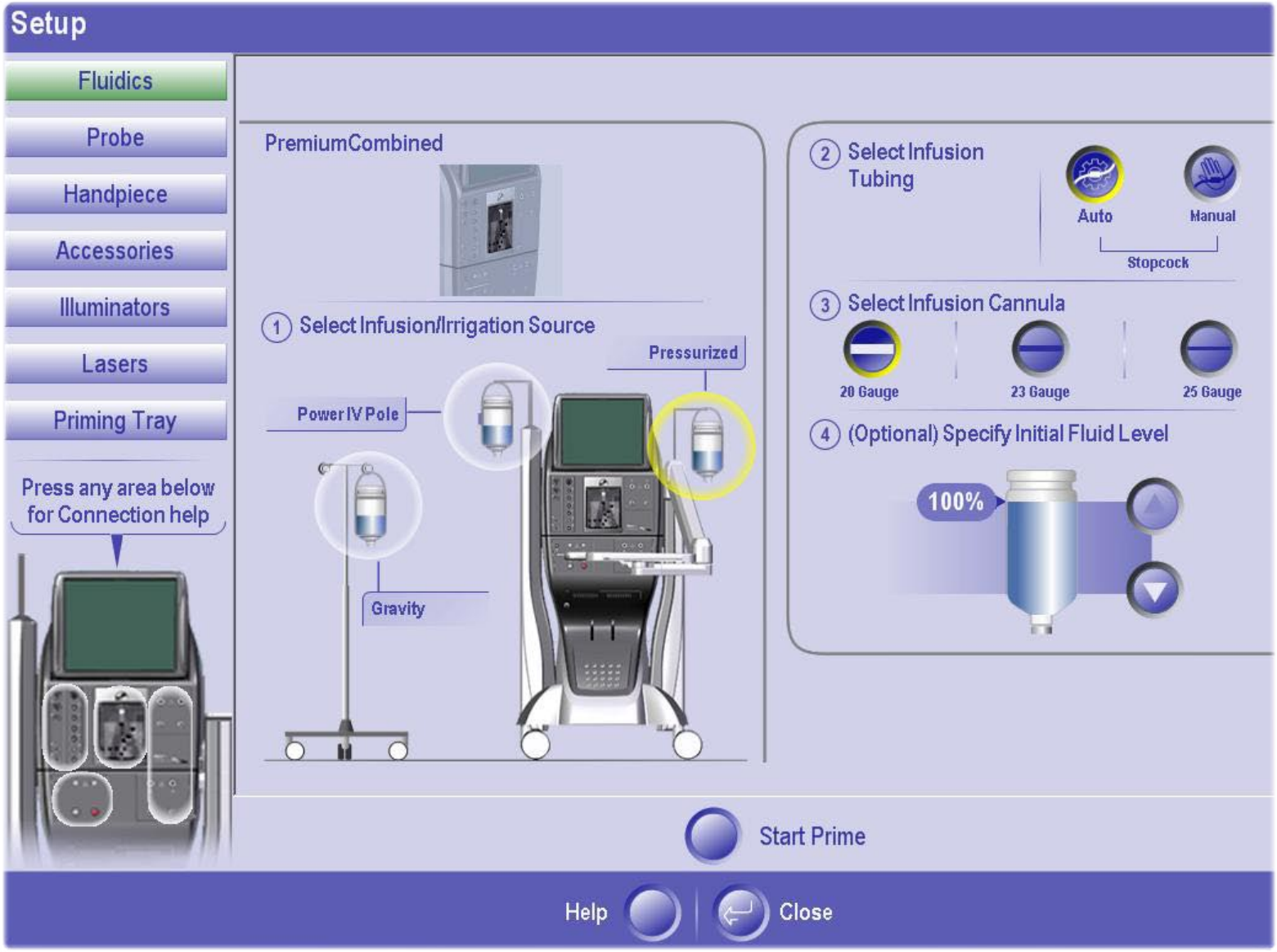


Figure 1-32 The Detailed Fluidic Setup Panel

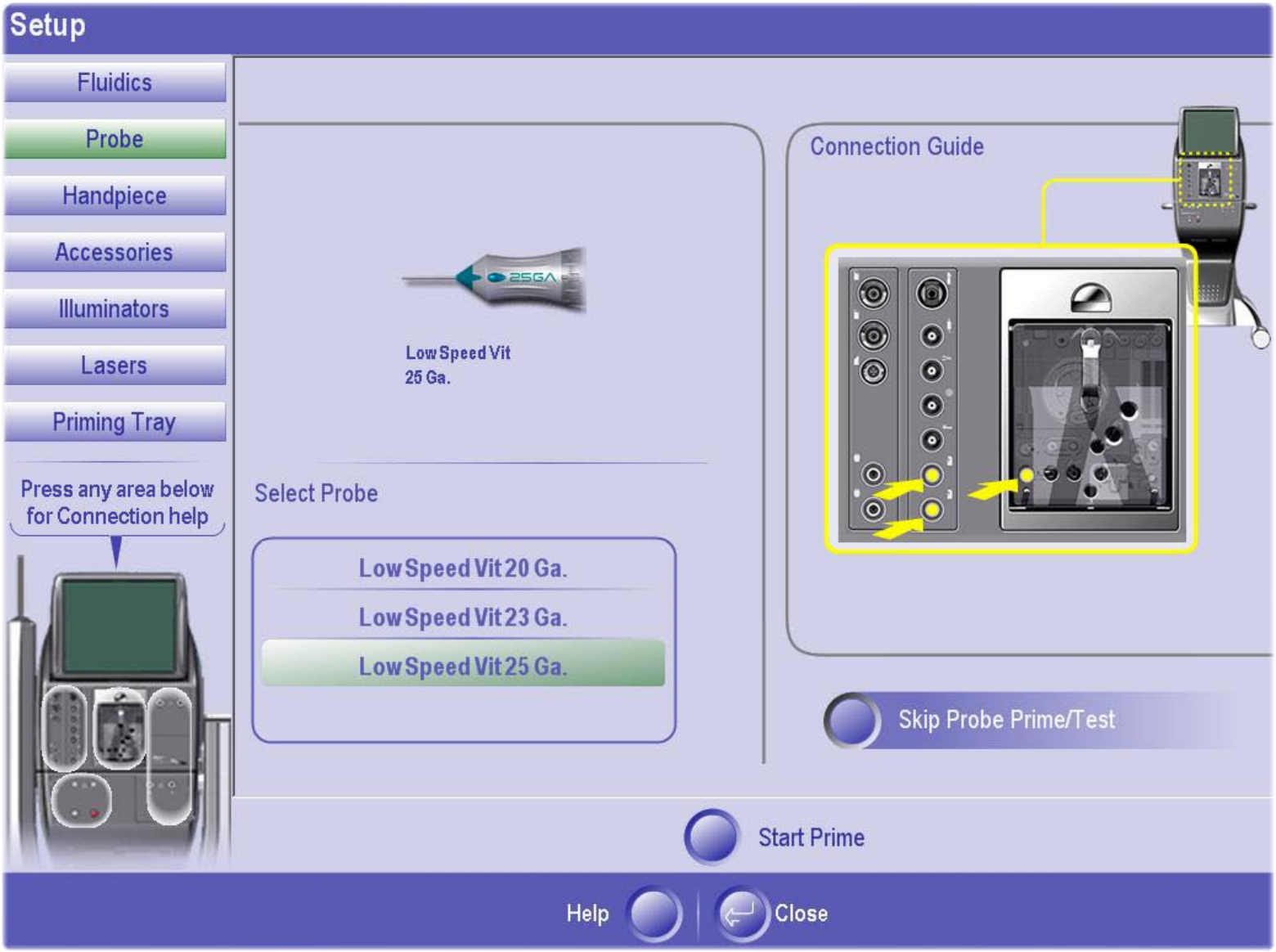


Figure 1-33 The Detailed Probe Setup Panel

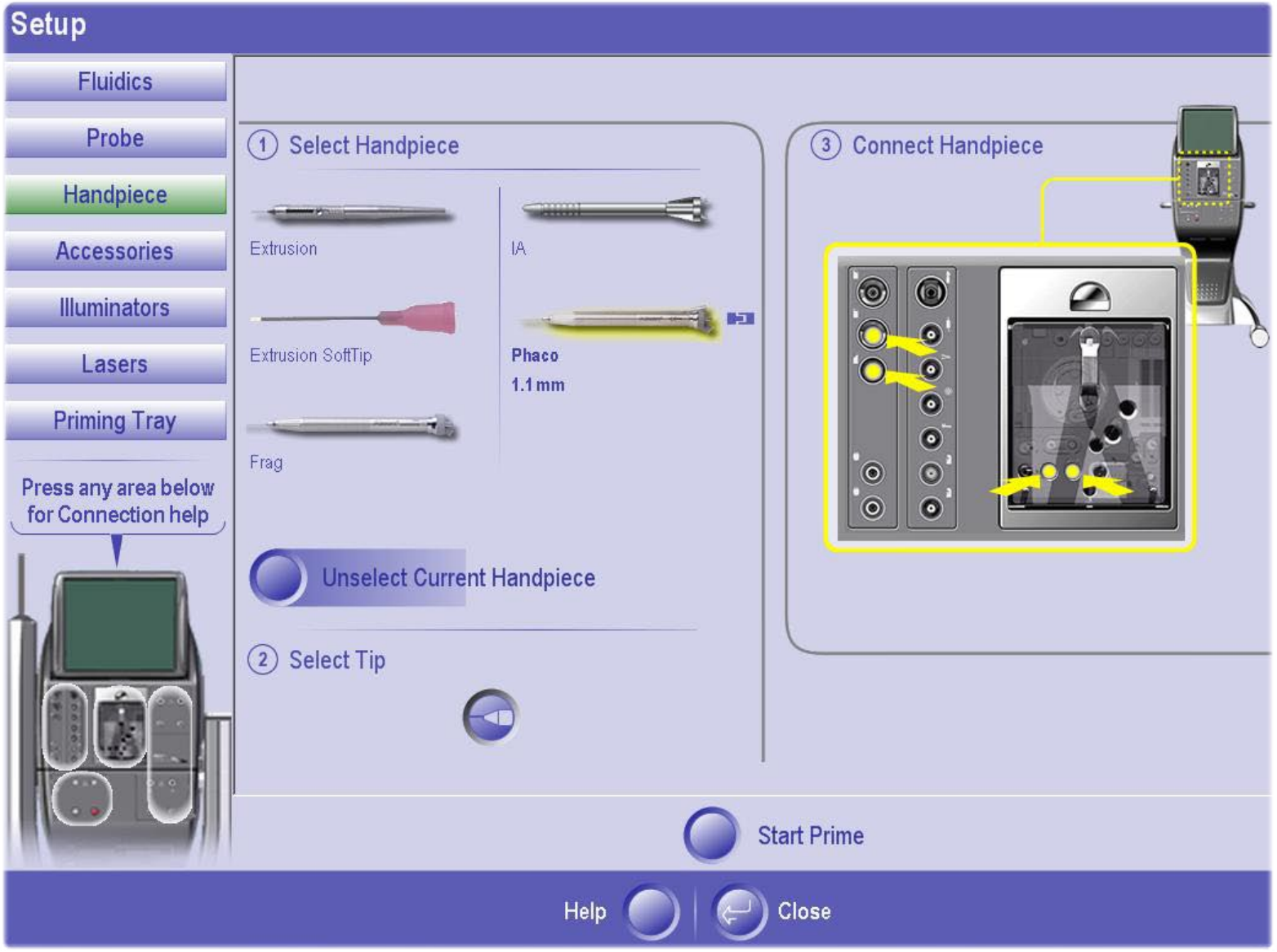


Figure 1-34 The Detailed Handpiece Setup Panel

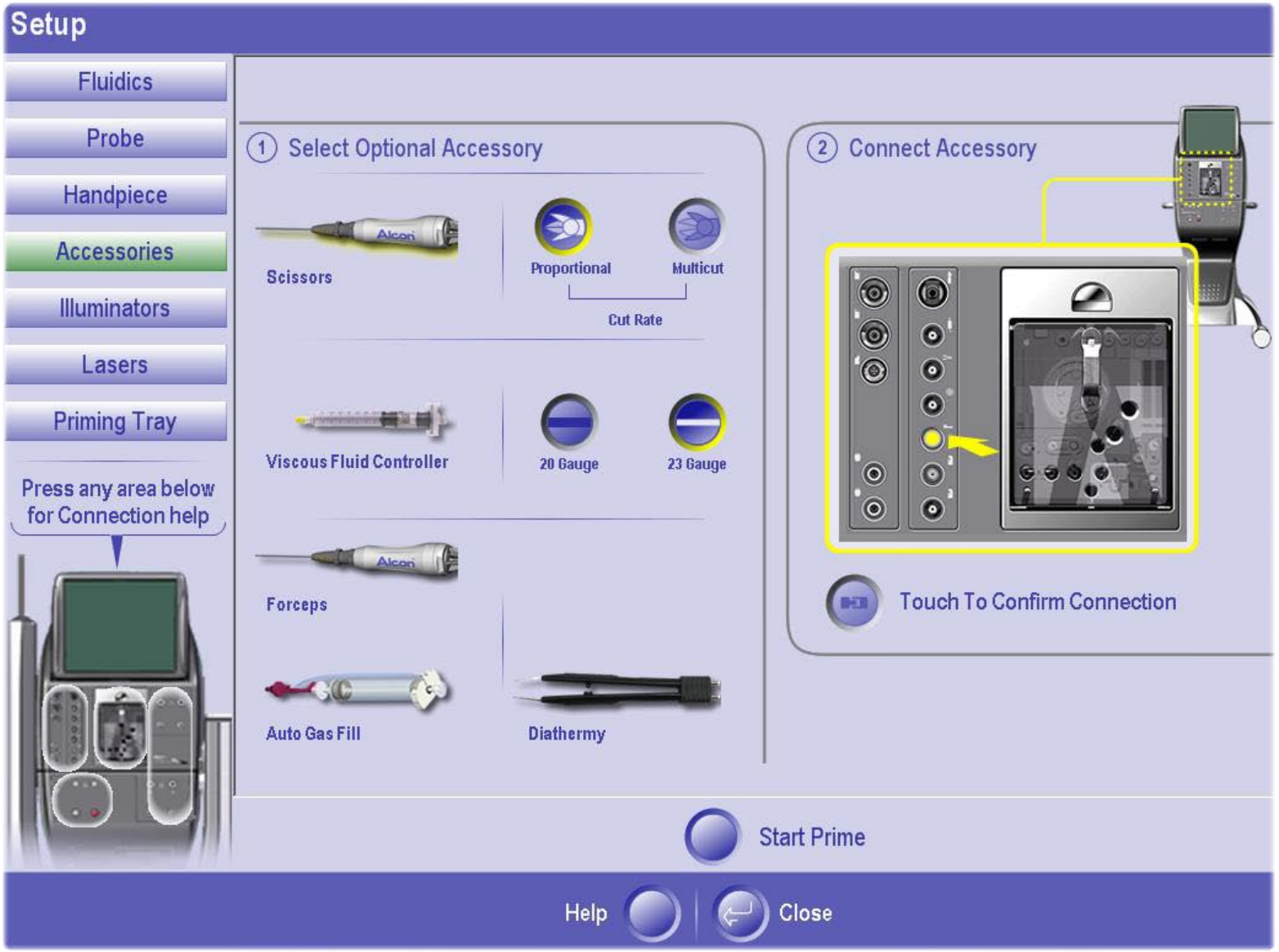


Figure 1-35 The Detailed Accessory Setup Panel

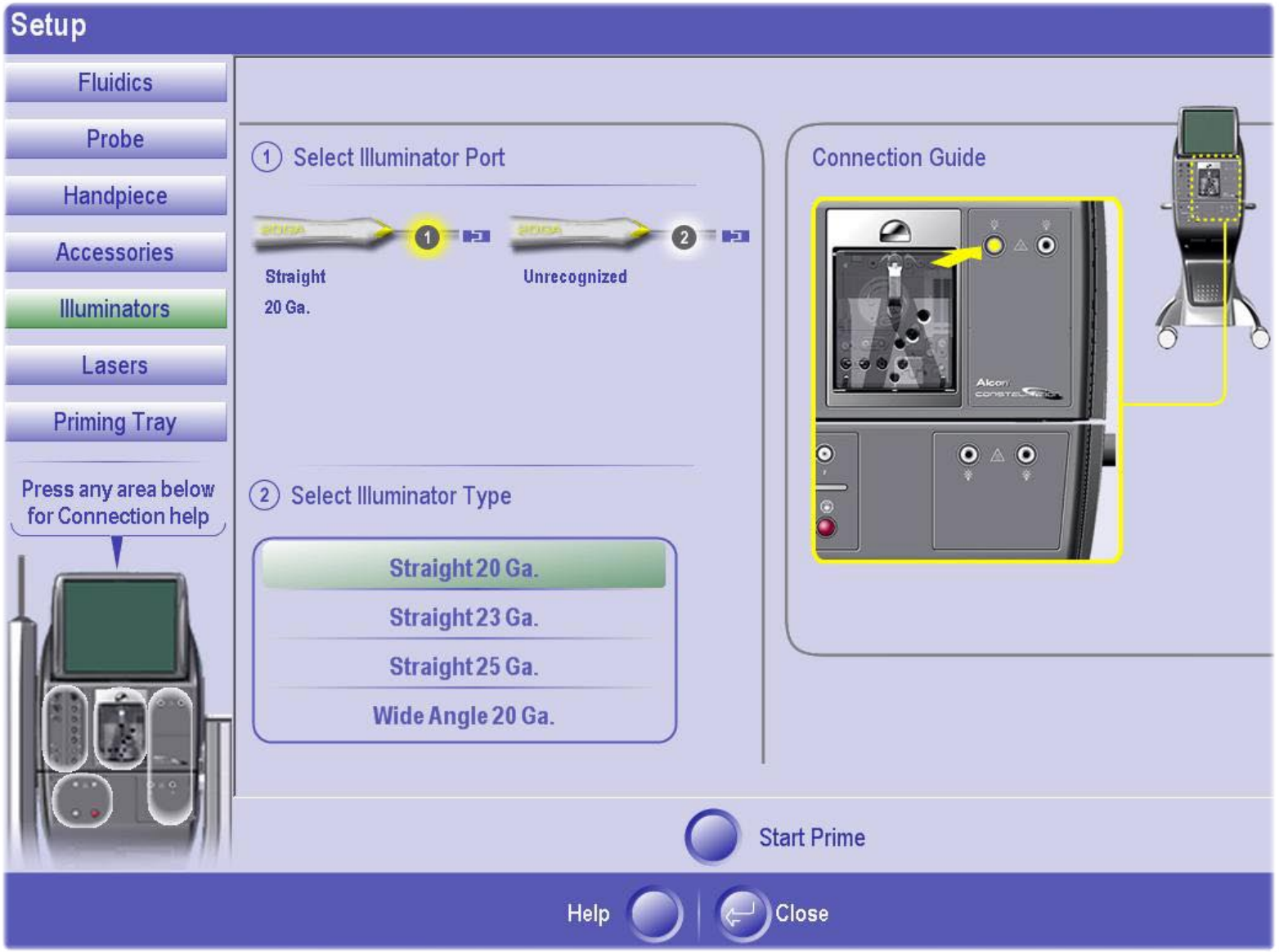


Figure 1-36 The Detailed Illuminator Setup Panel

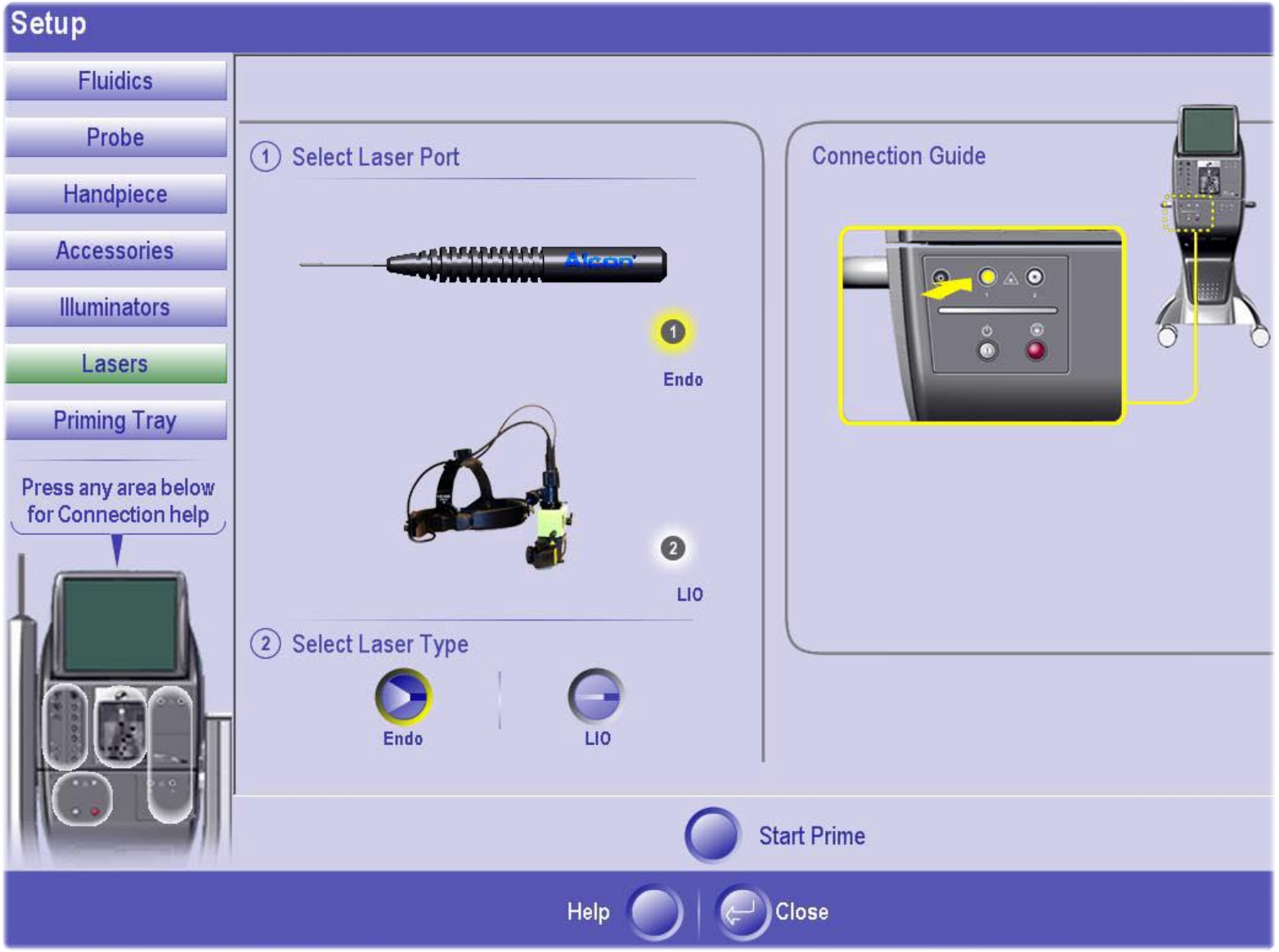


Figure 1-37 The Detailed Laser Setup Panel

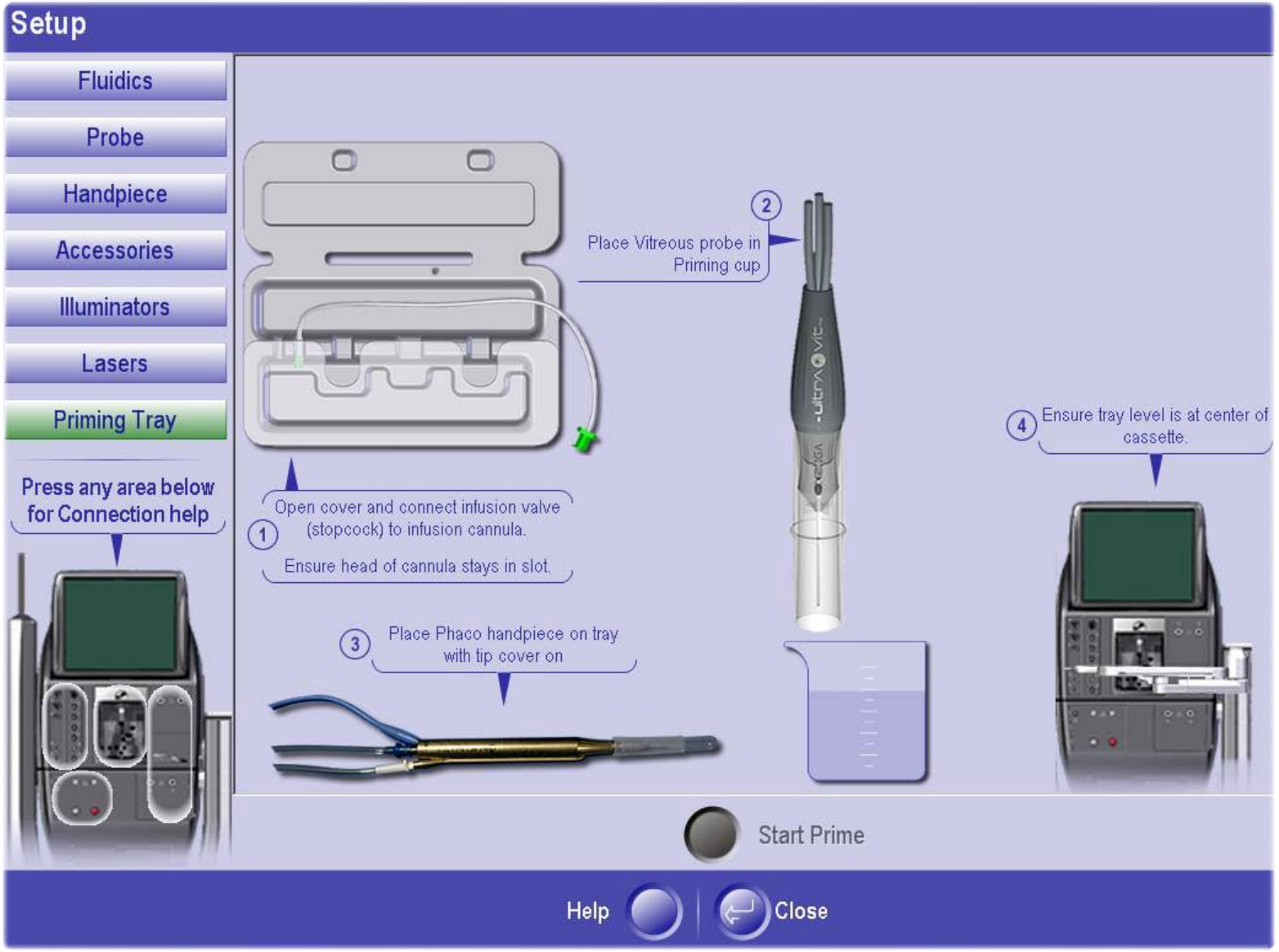


Figure 1-38 The Detailed Priming Tray Setup Panel

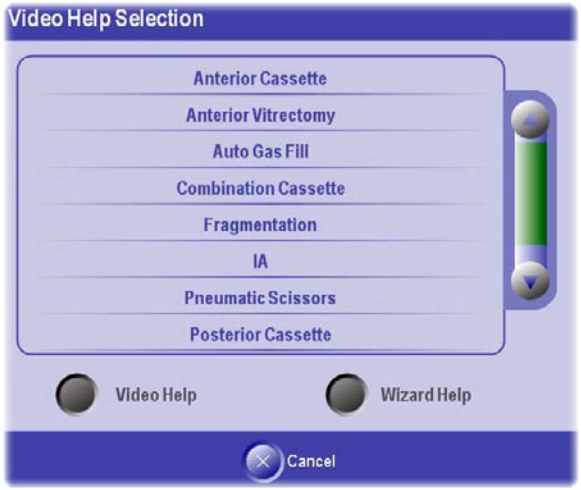


Figure 1-39 Video Help Popups

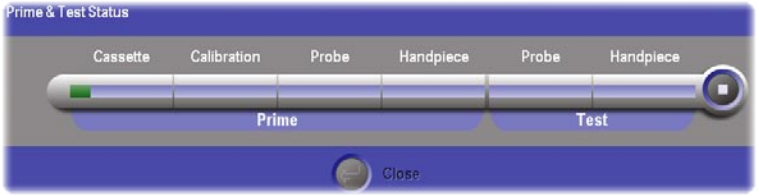


Figure 1-40 Prime & Test Status Bar

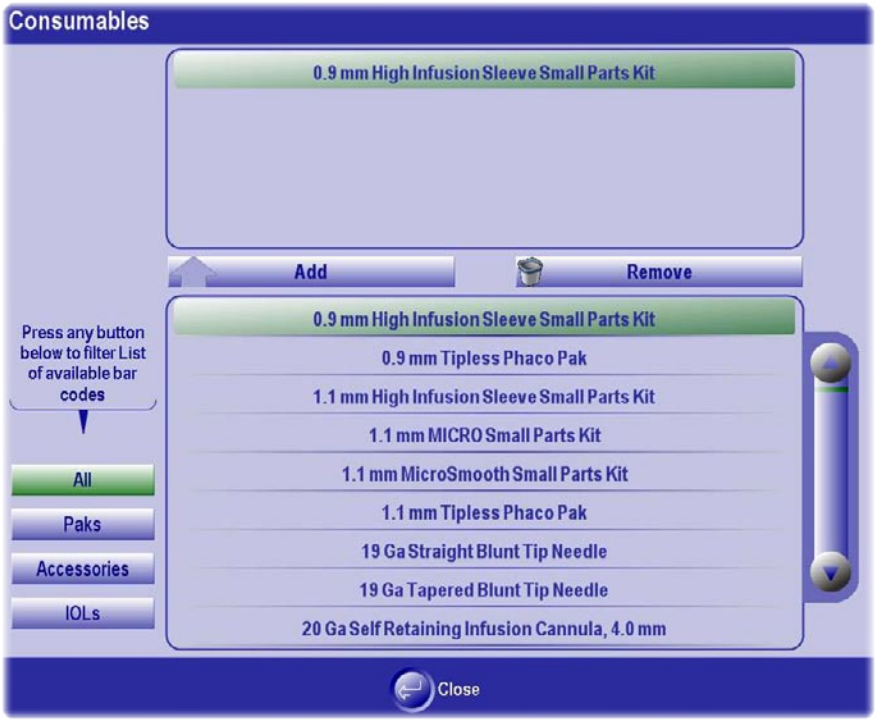


Figure 1-41 Consumables Popup

Figure 1-42 The Surgery Panel

Figure 1-43 Timer Popup

Figure 1-44 ***Accurus*® Classic Surgery Screen**

Figure 1-45 Vitrectomy Surgery Screen: 3D Submode

Figure 1-46 Vitrectomy Surgery Screen: Momentary Submode

Figure 1-47 Vitrectomy Surgery Screen: PropVac Submode

Figure 1-48 Vitrectomy Surgery Screen: VitWet Submode

Figure 1-49 Phaco Surgery Screen: Burst Submode

Figure 1-50 Phaco Surgery Screen: Custom Submode

Figure 1-51 Phaco Surgery Screen: Pulsed Submode

Figure 1-52 Phaco Surgery Screen: Continuous Submode

Figure 1-53 Fragmentation Surgery Screen: Fixed Submode

Figure 1-54 Fragmentation Surgery Screen: Linear Submode

Figure 1-55 Fragmentation Surgery Screen: Momentary Submode

Figure 1-56 Irrigation/Aspiration Surgery Screen

Figure 1-57 Extrusion Surgery Screen

Figure 1-58 Laser Surgery Screen

Figure 1-59 Forceps Surgery Screen

Figure 1-60 Scissors Surgery Screen: Multicut Submode

Figure 1-61 Scissors Surgery Screen: Proportional Submode

Figure 1-62 VFC Surgery Screen: Extract Submode

Figure 1-63 VFC Surgery Screen: Inject Submode

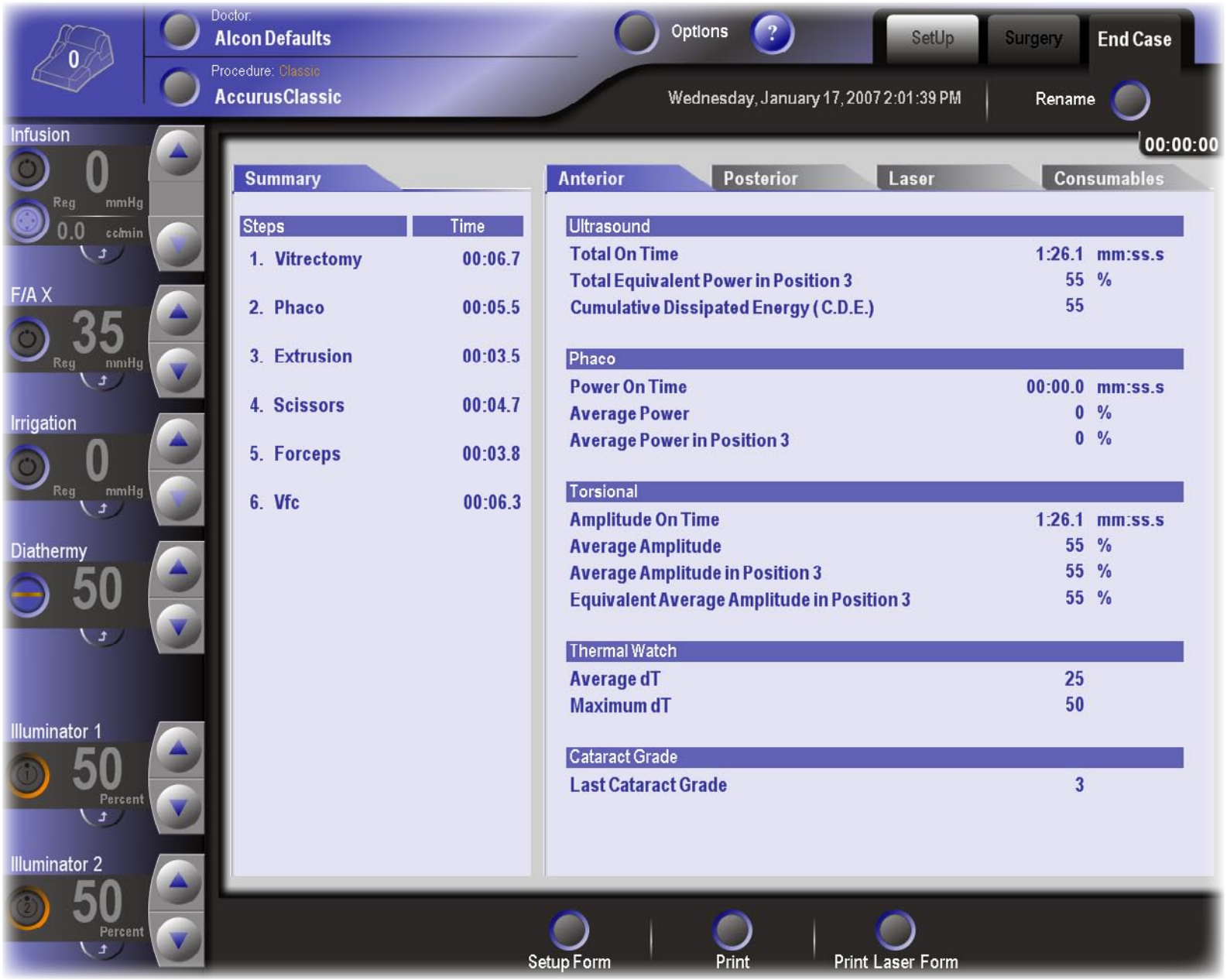


Figure 1-64 End Case Screen: Anterior Tab

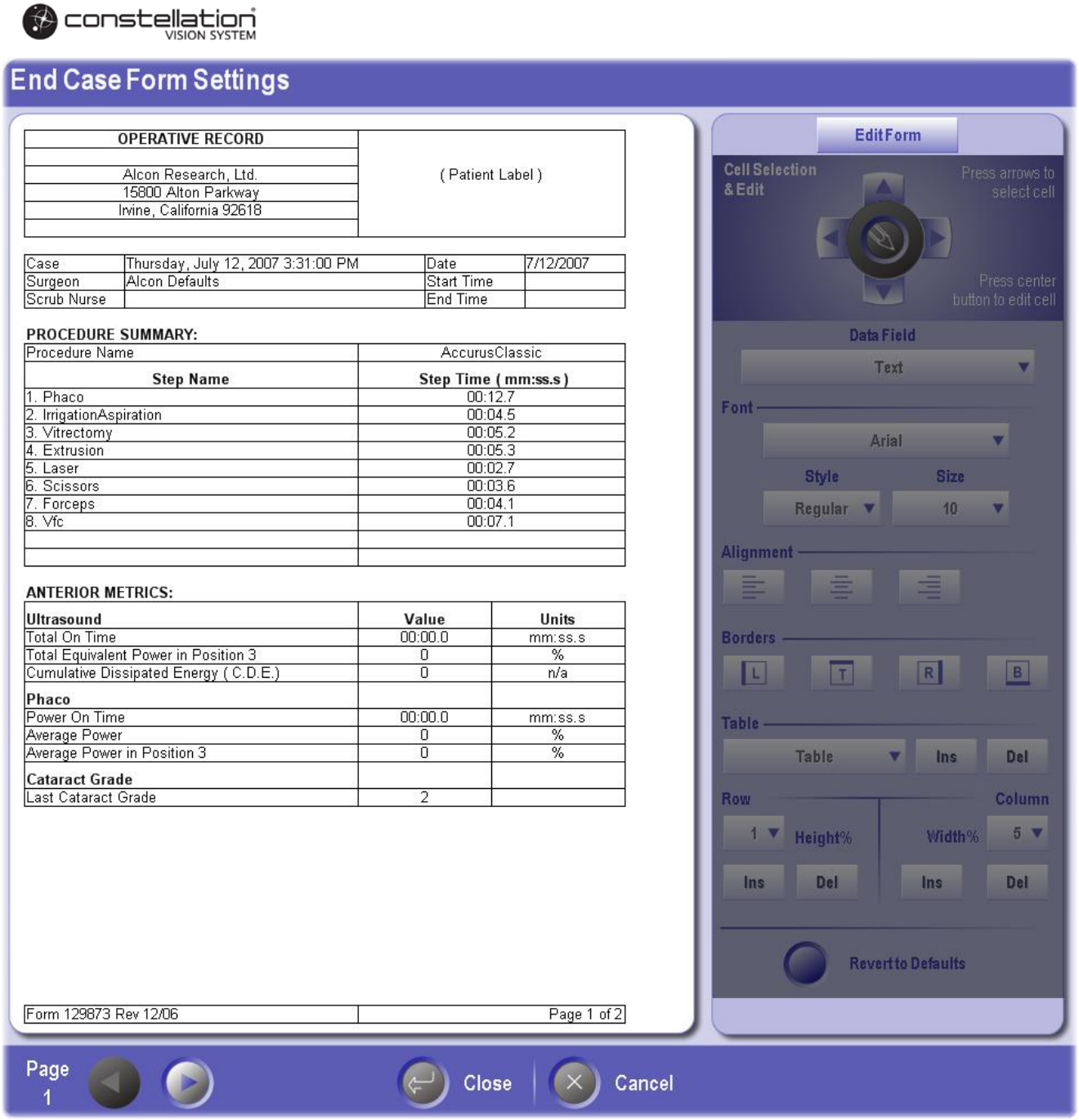


Figure 1-65 End Case Screen: Setup Form

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SECTION TWO
THEORY OF OPERATION

Constellation® Vision System Overview

The *Constellation*® Vision System can be used as a standalone tabletop system, or as a single monolith system when combined with the *Constellation*® base.

The Console and Base are fastened together mechanically and electrically to create the monolith assembly. The Console and Base are connected together electrically (power, communication, power supply) with cables between each component's rear panel connectors, completing the monolith assembly. Optional modules are connected through the appropriate connector on either the Console or Base.

Following is a general overview of all the modules that make up the *Constellation*® Vision System.

Console Power Module
The console power module distributes power through a single 24 VDC power bus. The power system as a whole is comprised of five major functional blocks:

- AC input
- Power conversion
- Power distribution
- Host battery backup including charger
- Dedicated host DC power converter module

The five blocks work together to convert a universal 90-264 VAC 50/60Hz input into a 24 VDC regulated power buss that meets the system's total power requirements.

Host Module
The host module provides the computing platform for the host software and Graphical User Interface (GUI). It is responsible for communicating configuration control to subsystems, and displaying subsystem real-time parameter data within context on the GUI. The host module is comprised of a PC motherboard, CPU, memory, peripheral devices, host power interface, and I/O expansion panel. The following features are part of the host module.

- Video Output - Provides video output for the front panel display and expansion panel VGA output.
- USB interface – Provides communication bus for touch screen, IR receiver, bluetooth transceiver, and external keyboard used for some maintenance functions.
- Expansion Connectors - These connectors provide external interfaces for video input, overlayed video output, VGA output, serial interface, tethered laser interface, USB, video recorder control, ethernet, and MP3 input.
- DVD R/W - The primary means to download software to the host. It is also used to write data on CD or DVD format disks.
- IR Receiver - Provides the means by which signals from the remote control are received and sent to the host via USB.
- WiFi Transceiver – Provides the means to communicate to the host via IEEE 802.11.
- Bluetooth Transceiver – Provides the means to communicate to the host via USB.
- Bar Code Scanner – Used to scan pak and consumable codes to pre-configure the machine for use.
- VideOverlay - Provides a means to overlay real time console settings over surgical video data, then view and record it on external video.
- Stereo Speakers – Emit tones and voice confirmation. Speakers are housed in the console and controlled via the host sound card.

Display Module
The display module is the main user interface. The display module contains the LCD (display), and the touch screen which is the primary user input device. The display module's major components are the display assembly and pivot mechanism.

Supervisor Module
The supervisor module controls, arbitrates, and coordinates communications with all of the system's modules via an ethernet backbone and individual reset lines. The supervisor module provides:

- The means to receive input from the attached footswitch.
- Communication with the power system to control the power up sequence.
- The means to directly control the illuminator module via an electrical interface.

Illuminator Module

The illuminator module is a bright light source which couples to an endo-illuminator probe to illuminate tissues in the eye. The illuminator module is equipped with fixed UV and IR filters to remove unwanted ultraviolet and infrared light energy. The module is controlled by the supervisor module.

Fluidics Module

The fluidics module is comprised of two major functional blocks: the individual fluidics cassette and the receiver mechanism. The receiver

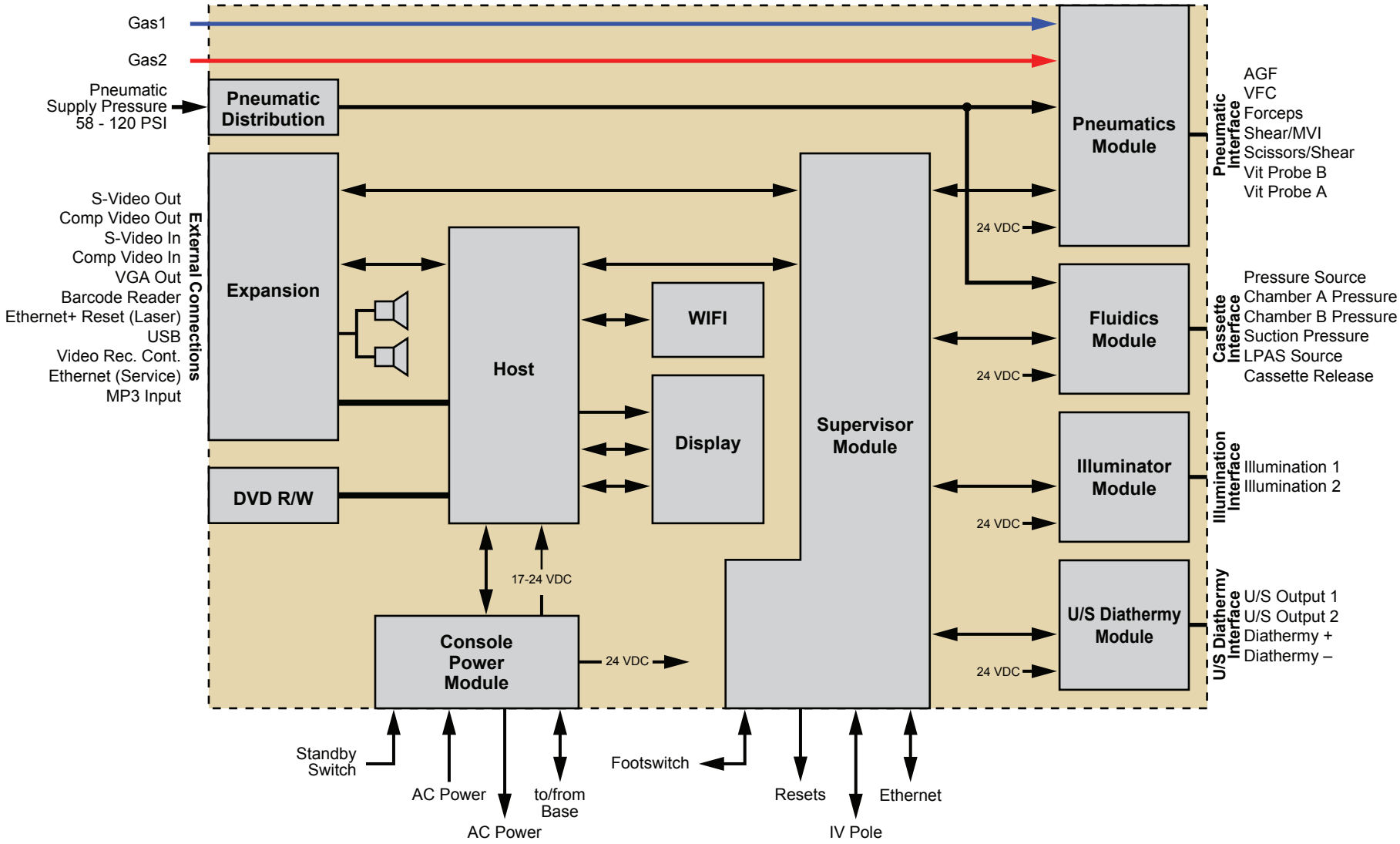

Figure 2-1 Tabletop Console Block Diagram

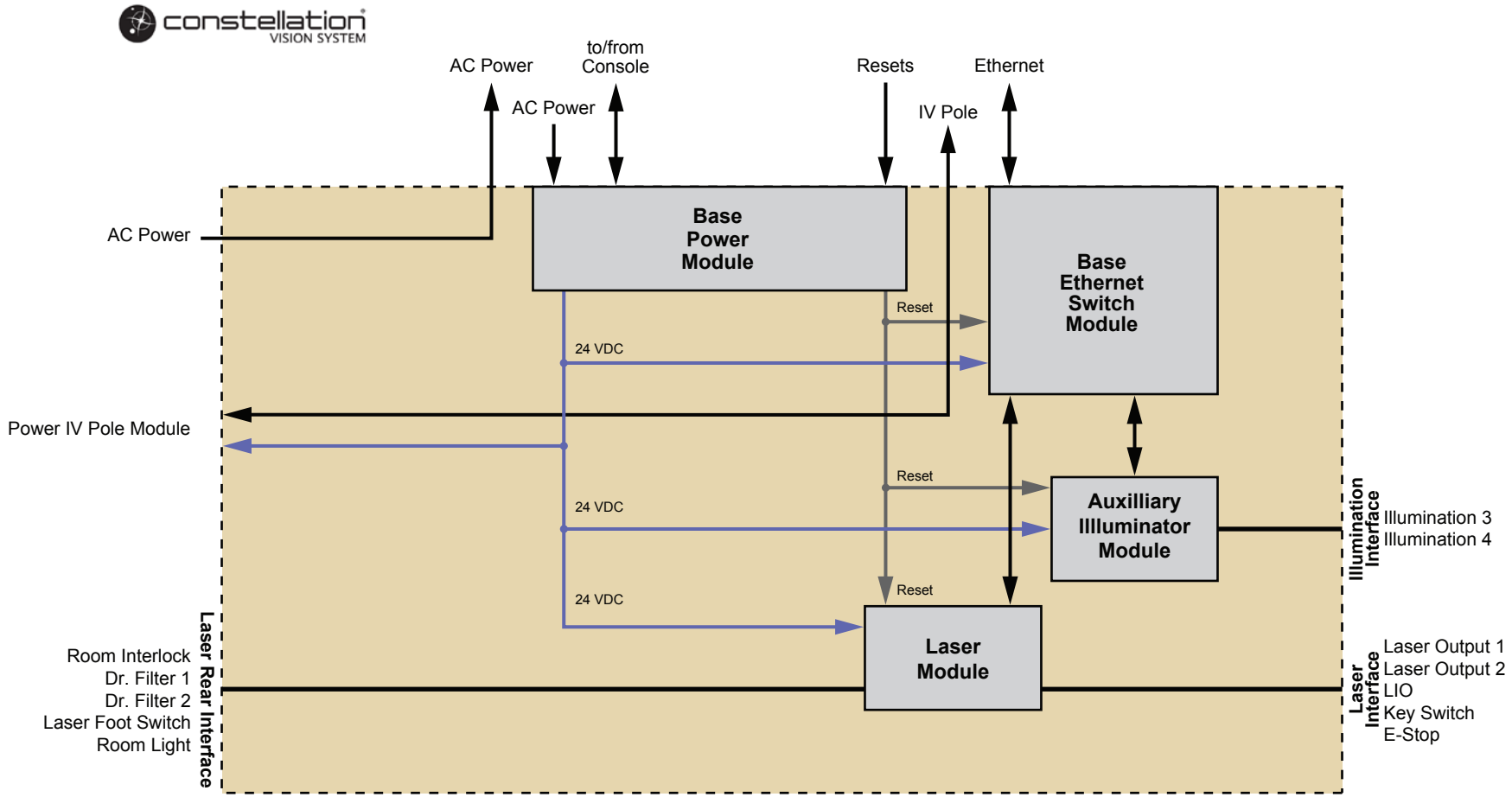

Figure 2-2 Base Console Block Diagram

mechanism consists of the following:

- Cassette Clamp Mechanism – Provides mechanism for securing the fluidics cassette to the console's internal fluidics system.
- Cassette Valve Pincher Actuators – Provides actuation to control fluid inputs/outputs.
- Module Controller – Provides control and communication of various module functions.
- Non-Invasive Flow Sensor – Senses flow.
- Infusion and Aspiration Level Sensors – Used to determine cassette fluid levels.
- Cassette Detection Sensors – Used to detect the presence of a cassette.
- Cassette ID Sensors - Used to identify various cassette types.
- Drain Pump – Used to transfer fluid from cassette to drain bag.
- LPAS Pump – Generates pressure for infusion.
- Infusion Subsystem – Controls and provides pressure necessary to maintain infusion.
- Irrigation Subsystem – Controls irrigation levels.
- Aspiration Subsystem – Controls vacuum.

These 12 elements, plus the fluidics cassette, work together to provide the necessary infusion, irrigation, aspiration, and LPAS functionality required by the *Constellation*® system.

Pneumatics Module

The pneumatics module is comprised of the following elements:

- Pneumatic Distribution - Distributes clean filtered supply of pneumatic source pressure to the pneumatics and fluidics modules. It also provides the point of connection for the console to the hospital supply pressure.
- Vit Probes Pressure Drive Ports - Provide pulsed pressure at a predetermined rate, duty-cycle, and pressure to drive pneumatic vitrectomy probes.
- Pneumatic Instruments Drive Ports - Provide either proportional pressure or pulsed pressure at a predetermined rate, duty-cycle, and pressure to drive pneumatic instruments such as forceps and scissors.
- Viscous Fluid Control Port - The VFC drive provides proportional pressure or vacuum to drive the VFC plunger to inject or extract viscous fluids.
- Auto-Gas Filling (AGF) Port - The auto-gas filling port provides the automatic function of filling the gas consumable with a gas tamponade.

U/S Diathermy Module

The U/S diathermy module provides the following functionality:

- Phaco and Frag Connectors - Provide the electric signals to drive the Phaco and Frag handpieces.
- Diathermy Connectors - Provide the electric signals to drive the diathermy and coagulation accessories.

Remote Control

The remote control provides a navigational interface remotely through the IR receiver.

Base Assembly (optional)

The base assembly provides the mounting platform for the table top console. The base assembly contains the following modules/functionalities:

- Base Ethernet Switch - Provided as an extension to the supervisor, and distributes ethernet and reset lines to the modules in the base assembly.
- Base Power Module - The base power module distributes power through a single 24 VDC power bus.

Tray Arm (optional)

The tray arm can be mounted on either the left or right side of the base. It provides a movable work surface for set-up and use during surgery.

Laser Module (optional)

The laser module converts 24 VDC input power into laser light at the output port where it is coupled to a fiber-optic handpiece cable. The laser rear interface provides the primary external interface to the laser module. It includes the room interlock, two Dr. filters, a laser footswitch connector, and room light connectors.

Auxiliary Illuminator Module (optional)

The auxiliary illuminator is a xenon light source which couples to an endo-illuminator probe to facilitate visualization of eye tissues. The auxiliary illuminator is equipped with fixed UV and IR filters to remove unwanted ultraviolet and infrared light energy.

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Power System

The *Constellation*® Vision System uses a modular architecture. Each major machine function such as pneumatics or fluidics is controlled by a dedicated module. Power for all modules is provided by a single 24 VDC power bus distributed throughout the system. The host computer is an exception as it is uniquely powered from a dedicated power source which automatically derives energy from the 24 VDC bus or backup battery pack, as appropriate.

This power architecture eliminates line leakage stack ups from individual modules, relieving the requirement for a large, heavy, and costly isolation transformer. In a stand-alone table top configuration the system leakage is below 350 uA. The combined top and bottom consoles total a maximum leakage less than 500 uA.

The power system as a whole is comprised of five major functional blocks: AC input, power conversion, power distribution, host battery backup (including charger), and a dedicated host DC power converter module. The five blocks work together to convert a universal 90-264 VAC, 50/60 Hz input into a 24 VDC regulated power bus that meets the *Constellation*® total system power requirements.

The table top (console) and monolith (console with base) configurations utilize the major functional blocks depicted in Figure 2-3. A brief description of each block follows.

- **AC Input**
  The AC input block provides the interface between the AC power line and the AC to DC power conversion block. The AC input block consists of an AC power entry module, over-current

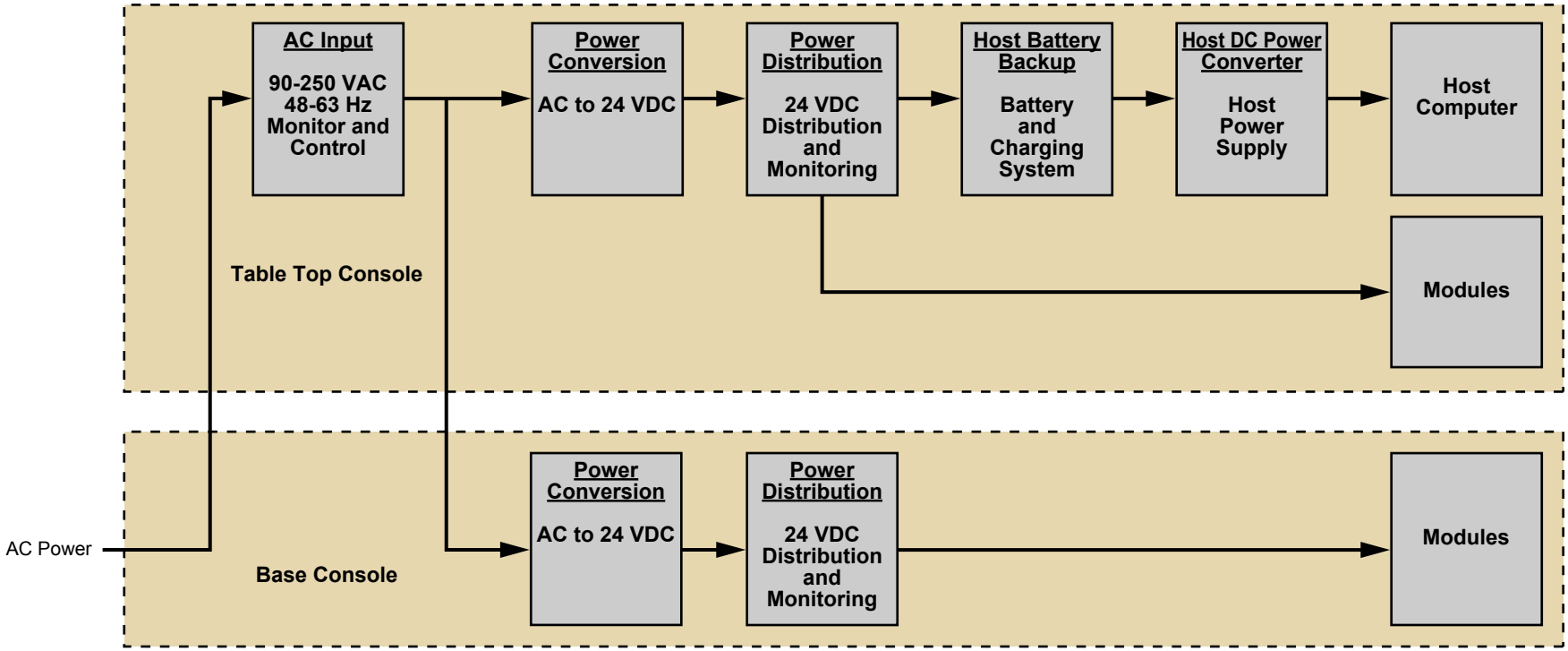

Figure 2-3 Five Major Power Functional Blocks

protection, EMI filter, and AC power distribution. The AC input block also includes AC voltage and current monitoring, and a serial communication port reporting results to a system supervisor.

- **Power Conversion**
  The AC to DC power conversion block consists of a single 24 VDC, AC/DC main power supply with wide input range capability. This supply has two outputs: a main 24 VDC and a low power logic level standby output. The entire system can be put into a sleep-mode by powering down the main 24 VDC output via a remote shut off input. The main 24 VDC output defaults to an off state when the system is first plugged into AC power, and remains off until an operator activates a wake-up standby switch. A microcontroller in the power distribution block controls the power down sequence when a shut-down command is issued by the operator via the host computer.

- **Power Distribution**
  The DC distribution block refers to the breakout of power to the individual modules. The main 24 VDC from each supply is brought on-board, then fanned out and distributed to the individual modules. Cable harnesses are used to connect the multiple 24 VDC output connectors to the individual modules. Additional circuitry is added to monitor voltage and current levels at key points throughout the board. Results are reported to the system supervisor.

- **Host Battery Backup**
  A rechargeable Li-ion battery is included in the system as a backup power source. The battery backup provides a dual function. It acts as a UPS, keeping the host alive if there is a loss of AC power, allowing for an orderly controlled shutdown of the host. It also provides power when the host is remotely commanded to wake up, permitting software upgrades to be downloaded without the need for AC power.

- **Host DC Power Converter**
  The host computer is based on an Intel Pentium class processor with a hard drive, DVD, DVI video controller, sound, USB, etc. The host power module generates the voltages necessary to run the host computer and its peripherals. This module derives its power from either the 24 VDC bus, or from the backup battery, as required.

Console/Base Integration

In a fully integrated system, the console and base mate to provide the full feature *Constellation®* system (monolith). In this configuration AC power enters the bottom console then is routed to the top. Once in the top console, AC is controlled and monitored, then distributed between the two consoles. To limit AC line in-rush current, the top and bottom power supplies are sequenced upon power up. The top console is first powered up, followed shortly by the base.

The 24 VDC power bus in the base is supported by its own dedicated power supply capable of delivering ample power to all base modules. The base's breakout board has minimal circuitry, and is generally used to fan out power to its modules.

Functional Block Description

An expanded power system block diagram showing a more-detailed signal flow is presented in Figure 2-4. The five major functional blocks discussed before are depicted by the shaded areas.

Along with the AC switching supplies and the backup battery pack, four circuit boards (AC Power, Power Controller, DC\DC Converter, and Bottom Power Distribution) constitute the full power system. An overview of each of the four PCB assemblies follows.

AC Inlet

For the monolith system, AC power enters the at the bottom of the base unit. The power is routed through the base to the top console AC inlet. (If the system is only the table top console, the power enters directly into the console's AC inlet.) The inlet incorporates a low leakage, high frequency, EMI filter. Power is then routed from the inlet receptacle to a combination On/Off rocker switch and thermal circuit breaker. From here the AC power is wired to the AC Power Board system level EMI filter.

AC Power PCB

The AC Power PCB performs three basic functions: AC power monitoring, AC power switching to base unit, and system EMI filtering.

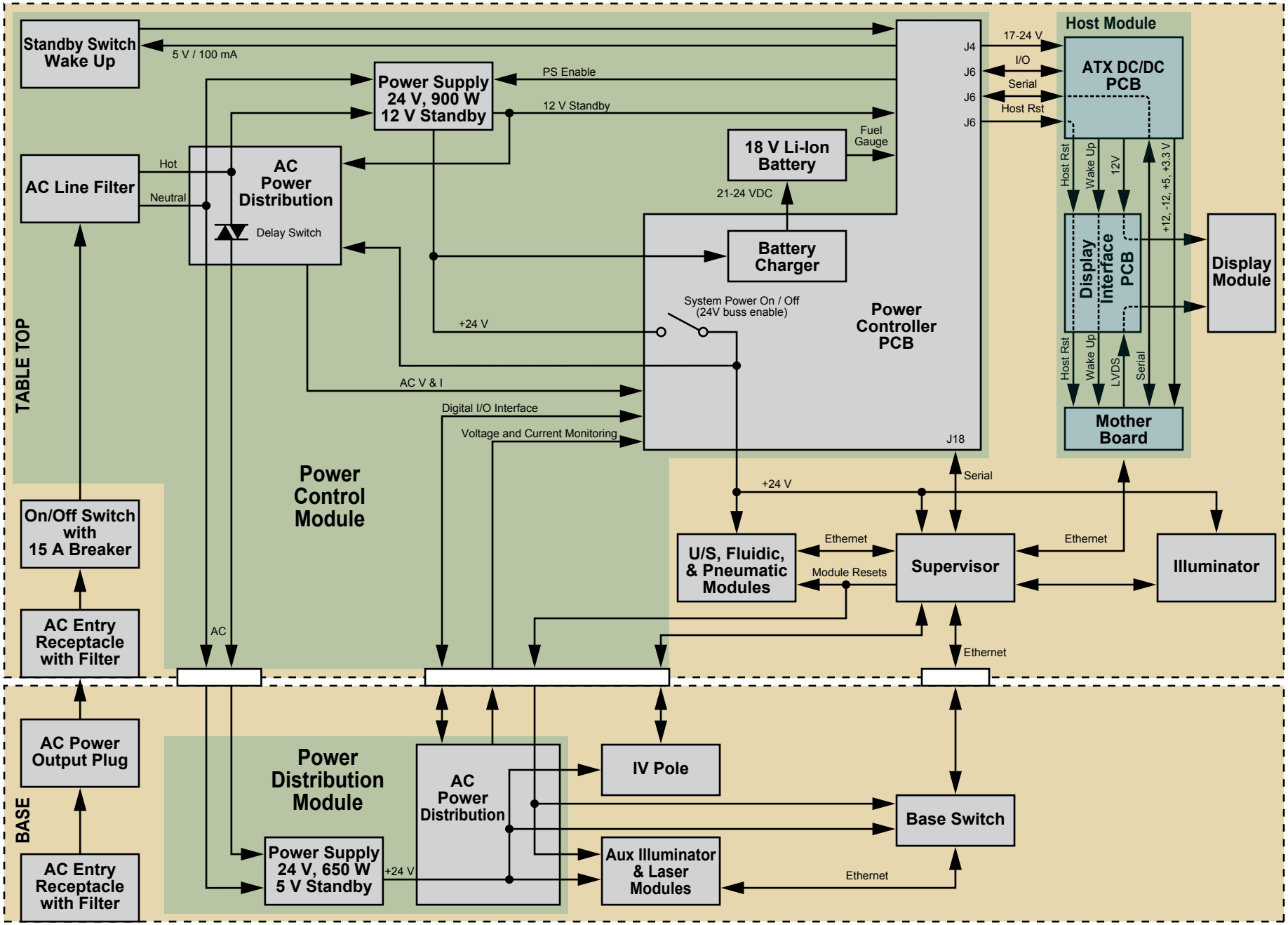

Figure 2-4 Power System Block Diagram

Power Controller PCB

As its name implies, the Power Controller PCB controls, monitors, and reports the status of the AC and DC power coming into the *Constellation*® system, as well as the power being distributed to all the sytem's submodules.

Power States

The power system can reside in any one of six power states; battery-powered sleep mode, wall-powered standby mode, e-connectivity mode, UPS host back-up mode, and full system power-up mode (see Table 2-1).

Control Logic Power

For e-connectivity wake-up purposes, the system utilizes the PIC processor's real time clock capacity. In sleep mode the main switcher power supplies are powered down. If there is no AC power, power must be derived from the 21 V lithium back-up battery pack. To ensure a long shelf life, battery drain must be limited below 1 mA, yielding about one year of operation before re-charge is required on an initially-full battery.

To conserve power in sleep mode, power is routed only to the PIC processor via a pair of back-to-back n-mosfets operating as a bi-directional power switch. A separate mosfet feeding all other logic is powered down. Steering diodes turn on the appropriate mosfets as various power sources are available; i.e., battery, standby, and host converter power.

In the event that the lithium battery is removed for servicing, a 1.5 Farad power capacitor keeps the real-time clock running for about one-half hour.

Standby Switcher Power

The top console switching power supply has a +12 V auxiliary standby power output, active when AC input is greater than 80 VAC. When the auxiliary voltage is present at the input to the micro power switching regulator, the battery back-up feed is disconnected by a mosfet switch.

Lithium Back-up Battery Pack

A nominal 21 V smart lithium battery pack provides sleep mode power for the system, as well as acting as the back-up and e-connectivity power source for the system. The pack has a 4.3 ampere hour rating translating to about 20-30 minutes of host run time under back-up or e-connectivity operation. Integrated smart battery electronics within the pack provide battery gas gauging capacity, indicating the ampere hours of capacity remaining at any given time by coulomb counting both charge and discharge currents.

Communication to the battery is maintained via a SMBus data link (battery industry modified I2C). The link provides detailed pack information including state of charge, cell voltage, temperature, current, date of manufacture, etc. In addition to the data link, the pack incorporates a thermistor which provides additional hard wired protection against overheating if the data link fails.

The pack is easily replaced by disconnecting a 10 pin Molex minifit connector, and removing Velcro straps holding the pack in a cradle.

Lithium Pack Charge Control

The charger has the capacity to operate fully independently; however, all charging parameters are available to the PIC processor via the SMBus communication link to control. As a safety precaution, hard-wired resistor values limits maximum charge voltage and current to the battery pack, regardless of higher software commands.

Power State	Description
Battery-Powered Sleep Mode	When main AC power off, system real time clock battery powered.
Wall-Powered Standby Mode	When main AC power switch is on, AC switching supply is active. System operates in standby mode, drawing system power from switcher auxiliary output until system is commanded on.
E-Connectivity Mode	When main AC power switch off, and e-connectivity is self activated, host operates from battery power.
E-Connectivity Standby Power	When main AC power switch is on, and e-connectivity is self activated, AC supply and host are turned on. The rest of system is held off.
UPS Host Back-Up Mode	Upon loss of AC power, all modules go into an off fail-safe mode, with exception of host computer which remains active operating from battery power until Windows OS can be properly shut-down.
Full System Power-Up Mode	All power is derived from AC switching power supply.

Table 2-1 Power States

Likewise, the temperature of the battery pack is hard-wire monitored via a thermistor located in the pack. If cell temperatures are too high, the charger will terminate the charge.

Host DC/DC Converter Input
The power provided to the host DC/DC converter ranges from 16 to 24 volts, dependent on the power source. The source can originate from the AC switching supply or a low level battery pack.

Microprocessor
The microprocessor used onboard is a PIC 16-bit processor (PIC18F6527) clocked by an external 10 MHz oscillator. In sleep mode, to reduce power consumption, the clock is switched over to a slower 32.768 KHz external oscillator and internal 8 MHz clock. The oscillator is also used as a time base for the processor's real time clock.

All inputs are ESD and noise protected before entering the board, and all outputs are buffered before exiting. This includes ESD and noise protection on the I2C lines.

Host Interface
Communication to and from the host is included in a single 14-pin connector (see Table 2-2).

Base Console Interface
Communication to and from base console is in single 16-pin connector (see Table 2-3).

Top Console Fan Cooling
Based on the temperature reading from the sensor above, the top console system fan is speed controlled via a PWM signal from the PIC processor. A fan fail monitor IC (MAX6684) monitors the fan's tach output signal. If the fan is not spinning for any reason, a fan fail signal is reported to the PIC.

The output lines to the fan are fully current-protected. If the output current exceeds one ampere, the gate of the output mosfet will be held low. As the PWM signal drops low, the latching circuitry is reset, thereby yielding a cycle-by-cycle self-resetting current limit.

Standby Switch
Under normal operation, the *Constellation®* console is turned on by depressing the system standby switch located at the back of the machine. The switch glows orange while in system standby mode, and blue once the console is activated. The switch input is both ESD and noise protected.

Top 24 V Supply Interface
Other than the main +24 V output from the AC supply, three signals are connected to the Power

Signal	Functional Description
RX1 & TX1	Pseudo RS232 interface passing measurements and status to host. Host passes real time clock updates and programming to PIC.
Display Enable	Activates +12 V power to display. (Not active in e-connectivity mode.)
Host Soft Reset	Direct soft reset line to motherboard.
Host Shut Down	Signal originating in motherboard calling for shutdown of its own power supply.
Host Power Good	Signal from host DC/DC converter indicating all voltages are regulation.
0V Return	Common 0 V reference return.
Laser Reset	Pass thru signal from supervisor to external laser system for cabling efficiency.
Supervisor 0 V	Supervisor 0 V reference used by laser reset.
Back Light Level	PWM signal controlling back light level of display. (Level initiated from the host through RS232 link to PIC.)

Table 2-2 Host Interface Signals

Signal	Functional Description
+24V Bottom	24V signal from base power board to monitor +24V level at base.
24V I Bottom	+24V buss current level signal from Base PCB scaled at 0.1V / Amp.
0VRefAnalog Bottom	0V reference from bottom console / base Power PCB.
Base Present	Loop back signal to 0V indicating base console interface connector is engaged and base console is present.
0V Ref Top	0V reference from top console to base Power Distribution PCB.
Over Cur Bottom	Signal drives low if base Power Distribution PCB detects a load higher than 30 amps.
Bottom Power OK	Active low signal if base console +24V is in regulation.

Table 2-3 Base Console Interface Signals

Controller PCB. The AC Good signal indicates the supply has sufficient AC voltage to remain in regulation. The +24 V enable signal turns on the main +24 V supply output when driven to 0.0 volts. A high enable level turns the output off (standby mode). The third output is the standby auxiliary +12 V used to power the circuit board during standby mode.

Supervisor Interface

Communication between the PIC and Supervisor is through an opto-coupled pseudo RS232 interface to maximize the signal-to-noise ratio. In addition, the external laser reset line is passed through the controller for cable wiring efficiency.

Host DC/DC Converter and Interface PCB

The host DC/DC Converter and Signal Interface PCB performs two primary functions. The first role is providing all voltages necessary to operate the host computer and motherboard; as such, the DC/DC converter mimics a standard 150 Watt power supply. The second function the board provides is electrical safety isolation between the host computer, all of its I/O, and the *Constellation*® internal electrical system. Isolation is necessary to meet safety agency requirements.

Communication lines between the host and *Constellation*® system are included in a single 14-pin connector with the exception of the ethernet network line. Isolation in this instance is provided in the ethernet coupling transformer on each side of the ethernet cable.

The interface cable between the host DC/DC Converter PCB and Power Controller PCB has a one-to-one pin assignment (see Table 2-4).

Bottom Power Distribution PCB

The primary function of the Bottom Power Distribution PCB is to provide an interconnect platform for the AC and DC voltages distributed throughout the top *Constellation*® console, as well as monitoring general environmental conditions of the base console, and reporting these to the top Power Controller PCB.

Top to Bottom Console Interface

A number of data lines are required to interconnect the top and bottom power boards (see Table 2-5).

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Signal	Functional Description
RX1 & TX1	Pseudo RS232 interface passing measurements and status to the Host. Host passes real time clock updates and programming to the PIC.
Display Enable	Activates +12V power to the display. (Not active in e-connectivity mode.)
Host Soft Reset	Direct soft reset line to the motherboard.
Host Shut Down	Signal originating in motherboard calling for shutdown of its own power supply.
Host Power Good	Signal from the Host DC/DC converter indicating that all voltages are regulation.
0V Return	Common 0V reference return.
Laser Reset	Pass thru signal from Supervisor to External Laser for efficiency in wire cabling.
Supervisor 0V	Supervisor 0V reference used by Laser Reset.
Back Light Level	PWM signal controlling the back light level of the display. (Level initiated from the Host thru the RS2323 link to the PIC).

Table 2-4 Host Interface Signals

Signal	Functional Description
Shield	Chassis ground line for cable shielding.
+24V Bottom	24V signal going to top console to monitor +24V power buss in base.
24V I Bottom	+24V buss current level signal from Base Board scaled at 0.1V / A.
0VRefAnalog Bottom	0V reference from bottom console / Base Power Board.
Base Present	Loop back signal to 0V indicating the bottom console interface connector is engaged and the bottom console is present.
0V Ref Top	0V reference from the top console to the Base Power Distribution Board.
Over Cur Bottom	Signal drives low if bottom Power Distribution PCB detects a load higher than 30 A.
Bottom Power OK	Active low signal if the base console +24V is in regulation.
Supervisor 0V Ref	Supervisor 0V reference used by reset signals routed to each module in base.
Reset 7-10	Reset lines 7 thru 10 routed to each module in the base.

Table 2-5 Top to Bottom Interface Signals

POWER UP SEQUENCE

1. With power cord plugged into AC outlet, turn On/Off rocker switch/breaker, located on rear of table top, to the ON position. The Power Controller PCB receives 12 V from the 900 W power supply and converts/sends 5 V / 100 mA to the standby switch; its button illuminates amber.
2. Press the amber standby button to begin powering up the system. The button turns blue to indicate the boot sequence has begun.
3. The Power Controller PCB sends the PS enable signal to the 900 W power supply to allow 24 V to go through the battery charger to the 18 V Li-Ion battery and back to the Power Controller PCB which then delivers 24 V to the Host ATX DC/DC PCB through J4.
4. The ATX DC/DC PCB sends -12 V, +5 V, +3.3 V to the Motherboard. It also sends +12 V to the Display Module through the Display Interface PCB.
5. After a few minutes, the Host Module sends a message back to the Power Controller PCB through J6, triggering +24 V 900 W power supply to the table top modules and supervisor.
6. After the table top modules successfully report back to the Supervisor, and if Table Top is connected to a Base unit, a Host signal triggers the delay switch which allows AC power to enter the Base 650 W power supply and its modules.
7. Once Table Top modules (and Base modules, if present) report back to the Supervisor, the Supervisor sends a message through the ethernet indicating it has taken control.

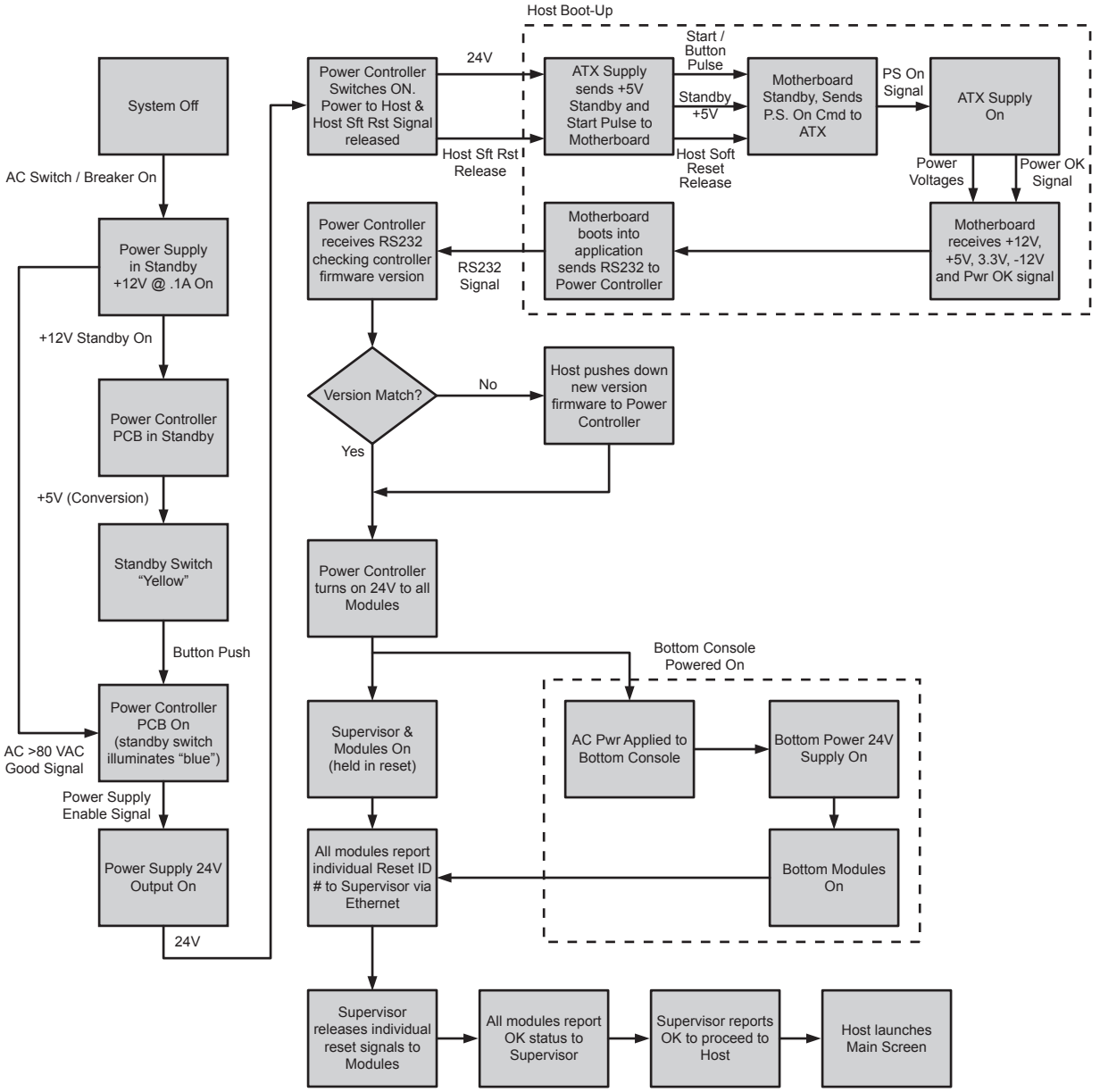

Figure 2-4a Power Up Sequence

Host & Expansion Panel

General Overview

The *Constellation*® Host module provides the computing platform for the Host software and Graphical User Interface (GUI). It communicates system level controls to subsystems via the Supervisor module (see Figure 2-5).

The Flex ATX Motherboard receives all necessary DC power (ATX power) from the Host DC-DC Converter PCBA, which also supplies DC power for the hard disks and DVD read/write drive. The PCI cards receive power directly through PCI slot connectors to perform specific functions of each board.

The Expansion Panel at the rear of the *Constellation*® console serves as the main user interface for external device connections. It has two horizontal rows of connectors, upper and lower, clearly labeled for their intended applications. The panel assembly contains upper and lower Expansion PCBA's, a Wi-Fi antenna cable connector, and cables from the Flex ATX Motherboard.

The Host module is composed of the following:

- Flex-ATX Motherboard
- VideOverlay PCBA (PCI)
- Wi-Fi PCBA (PCI)
- Two SATA hard disk drives
- DVD read/write drive
- Host DC-DC Converter PCBA
- Host Display Connector PCBA
- All required interface cables

Flex ATX Motherboard

The Flex ATX Motherboard contains an *Intel*® Pentium M745 1.8 GHz CPU with cooling fan, and a 1 GB DDR SDRAM (two slots available). Two embedded chipsets are also included on the motherboard:

- The *Intel*® 855GME Graphics and Memory Controller Hub (GMCH) is responsible for 24-bit LVDS, AGP/DVO, VGA graphics interface support, and 184-pin DDR333 memory.
- The *Intel*® 6300ESB I/O Controller Hub (ICH) supports 32-bit, 33 MHz PCI 2.2 bus connectors, 10/100 Ethernet port, ATA100, SATA150, USB, and Serial I/O interfaces.

The system BIOS on this board stores all the preferred configuration default settings so that when the CMOS looses its battery power, only the date and time information must be re-entered.

Display Interface

The motherboard has the ability for analog and digital display through an *Intel*® Extreme Graphics 2 controller.

- The analog display support is provided by a 350 MHz integrated 24-bit RAMDAC, and the VGA Monitor connector is located on the real I/O as a 15-pin female D-sub connector for analog monitors up to 2048x1536 resolution at 75 Hz.

- The LVDS port supports single or dual channel LVDS with 18/24-bit open LDI up to UXGA panel resolution, and is located internally as a 40-pin ribbon connector. It connects to the Host Display Connector PCBA, then the LVDS signal is sent to the front panel LCD display.

Audio Interface

The Flex ATX Motherboard employs an AC97 version 2.3 subsystem using the Realtek ALC655 codec to support Audio-In (MP3), Audio-Out (speakers), Mic (not used), and internal DVD interface (not used). Audio amplification of stereo sound input takes place on the Host DC-DC Converter PCBA and is sent to the two speakers.

Peripheral Interfaces

The Flex ATX Motherboard has two serial ATA IDE interfaces, two parallel ATA IDE interfaces (only one used), s-video and composite video connectors, four serial RS-232 ports, four USB 2.0 ports (two external [only upper one used], two internal), ATA-66/100 support, PS/2 keyboard (not used) and mouse ports (not used).

- **Serial ATA HDD -** Two SATA hard disk drives (SATA0 & SATA1) are used as non-removable storage devices for OS software, host software, GUI software, and to support the high-speed data transfer of 1.5 GB/s.

  The two hard drives are configured as soft-RAID1 for its fault-tolerance benefit. The mirrored pair of two hard disks increases reliability exponentially over a single disk. Each hard drive contains a complete copy of the data and can be addressed independently.

- **Parallel ATA DVD Burner -** One parallel ATA IDE interface is used to install software, and to back up system & data files. This removable data storage device is located on the mounting tray directly above the motherboard's CPU fan within the host enclosure. The drive is accessible from the rear of the console to load and unload a DVD disc.

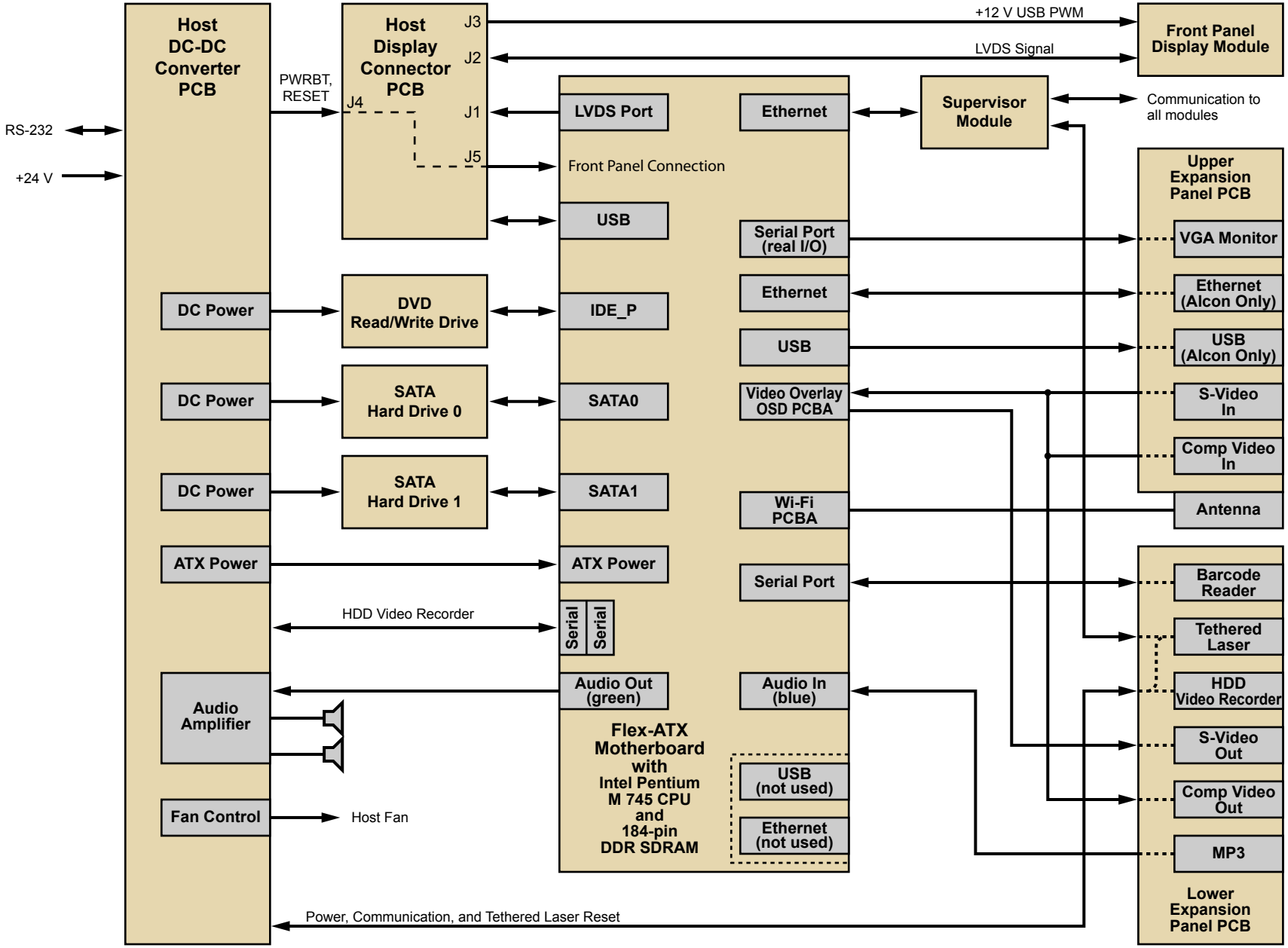

Figure 2-5 Host and Expansion Module Block Diagram

The DVD drive is a 5.25-inch half-height internal ATAPI DVD writeable drive. This drive can read digital data stored on CD-ROM, CD-R, CD-RW, DVD-RAM, DVD-ROM, DVD-R, DVD-RW, DVD+R, DVD+RW and CD audio discs. It can record digital data on DVD-R, DVD-RW, DVD+R, DVD+RW, CD-R, and CD-RW discs. It supports the RPC II format.

- **Video Overlay -** The Video Overlay Module (VOM) is comprised of two main components: a PCI card with video overlay capability (inside of Host module), and an external DVD recorder with RS-232 serial ports (recorder not supplied with *Constellation*® system)

  The VOM allows the user to add information (such as system status, settings, and parameters) to the live video being captured during the surgical procedure. This added data (text and graphics) is laid on top of the incoming video from the surgical scope. The resulting video/ data can be viewed on an external monitor in real time and/or recorded using an external DVD recorder.

  The video overlay function is implemented by an On Screen Display (OSD) PCI card, installed in a Host PCI slot. The OSD card has the capability to accept either an s-video or a composite video input in either PAL or NTSC format, and to output the combined video and overlay data in the same format as the incoming video.

External DVD Recording

DVD recording of the output video can be accomplished using an external real time DVD recorder (such as the Sony DVO). The *Constellation*® system provides a dedicated RS-232 port (REC), accessible by the user via the expansion panel, to control Start/Stop recording of the external DVD recorder, which can be controlled using the footswitch. This feature requires the external recorder to provide an RS-232 port with remote start/stop capability.

Barcode Reader

Barcoding is a type of Morse code used to encode information into a universally-recognized code language in the form of a barcode pattern. The barcode reader decodes a barcode by shining a light source across the barcode and measuring the intensity of light reflected back by the barcode. The pattern of reflected light is detected with a photodiode, which produces an electronic signal that exactly matches the printed barcode pattern. This signal is then decoded and transmitted to the *Constellation*® application software. A barcode system consists of a barcode printer, barcode labels for identification, scanning equipment for data collection, a database for barcode data analysis, and relay.

A handheld laser scanner (MS9544 by Metrologic) is used to scan the barcode labels that are printed on each consumable pak. It is a RS-232-based device that can read both 1D and 2D types of barcodes.

The *Constellation*® system provides barcode reading capability via a dedicated barcode reader connector on the expansion panel (||||||||||). The handheld reader scans the product's barcode label and transmits the raw data to the Host module. The data processing software decodes the product identification and compares it with the product database, allowing the product information to aid in system setup, keep track of products used during procedures, keep metrics, and keep inventory of products used. Once each consumable pak is scanned, it enables the *Constellation*® system to set itself up accordingly and offer on-screen help information to the OR staff.

Wireless PCI Adapter

The Wi-Fi card (Wireless-G PCI card) is used in the *Constellation*® system for wireless network connectivity with the internet, printer, and other future applications, utilizing its external antenna. The Wi-Fi card operates in the 2.4 GHz frequency spectrum with throughput of up to 54 Mb/s in Wireless-G mode. It complies with IEEE 802.11g standards and is backwards-compatible with IEEE 802.11b products.

Operational Description

The Host module is a PC with two Alcon custom PCBA's (Host Display Connector PCBA and Host DC-DC Converter PCBA), several OEM boards and storage devices (HDD & DVD), and interconnecting cables residing in the Host enclosure chassis. The chassis is equipped with the Host cooling fan/duct cover on the top. The Expansion Panel assembly is basically an extension platform of the Host module's signal ports for various applications. Two Alcon custom PCBA's (Lower and Upper Expansion) are included in the Expansion Panel assembly along with the associated extension cables.

Host Display Connector PCBA

The Host Display Connector PCBA is basically a connector interface board that distributes signals and power between the Host DC-DC Converter PCBA, Motherboard, and Front Panel Display Module.

LVDS Video Signal Interface

The Host Display Connector PCBA receives two channels (A, B) of LVDS data & clock signal pairs and supply voltage (+5 V) from the Motherboard's LVDS port via a 40-pin flat ribbon cable. These signals are routed to a 26-pin connector (J2) so that the LVDS cable can be connected from outside of the Host enclosure for easy cable installation to the Front Panel Display Module.

Display Power Signal Interface

The Host Display Connector PCBA receives 12 V backlight inverter input power and the backlight brightness control (PWM) signal from the Host DC-DC Converter PCBA via connector J4. These signals are routed to a 14-pin connector (J3) so that the LVDS cable can be connected from outside of the Host enclosure for easy cable installation to the Front Panel Display Module. Two signals (PWRBT, RESET) from the Host DC-DC Converter PCBA enter the Host Display Connector PCB at J4 and are passed through connector J5 to the Motherboard.

The Host Display Connector PCBA also relays a separate +12 V input power via the LVDS port ribbon cable to supply the power to the Host Front Panel PCBA in the Front Panel Display Module as input power for the circuitry.

The Host Display Connector PCBA relays USB signal pairs from the Host PC's front panel connector through connector J3.

Upper Expansion PCBA

The Upper Expansion PCBA is used to provide an external I/O interface between the Host module and external devices. The PCBA is mounted in the upper section of the expansion panel to support the top row of I/O connectors at the rear of the console.

- **Analog Display**
  The analog display signal from the Motherboard serial port on the rear I/O connects to the external VGA Monitor 15-pin female connector. Two transient voltage suppression (TVS) diode arrays are used both on the analog and digital signal lines for electrostatic discharge (ESD) protection of the I/O data lines. This device has an array of surge rated diodes with internal TVS diode. During transient conditions, the steering diodes direct the transient to either the positive side of the power supply line or to ground. The internal TVS diode prevents over-voltage on the power line, protecting any downstream components. The TVS device has a typical capacitance of 3 pF, and operates with virtually no insertion loss to 1 GHz.

- **Service Ethernet**
  The Ethernet signal from the Motherboard connects to the external RJ-45 Service Ethernet connector with built-in magnets. The TVS diode arrays are used on TX+, TX- signal pair and RX+, RX- signal pair for ESD protection. The TVS device has a typical capacitance of 3pF and operates with no insertion loss to 1GHz. The RJ-45 jack used for external Ethernet cable connection has an internal 1:1 transformer with 1.5KV dielectric withstanding capability and common mode chokes for filtering.

- **USB Connector**
  The USB 2.0 signal from the Motherboard (using top port only) connects to the external USB-A receptacle connector which is normally blocked externally and is available for Alcon service personnel use only. One TVS diode array is used on USB signal pair for ESD protection. The TVS device has a typical capacitance of 3pF and operates with no insertion loss to 1GHz.

- **Video Overlay**
  The Video Overlay PCBA can accept two types of signals (S-Video or Comp Video). The external connectors are a 4-pin Mini-DIN connector for S-Video In, and a 75-ohm BNC jack for Composite In. The S-Video Out and Composite Video Out connectors are located on the Lower Expansion PCBA. However, the composite video out signal is relayed through the same cable as the S-Video In and Composite Video In signals. Two TVS diode arrays are used on these video signals for ESD protection. The TVS device has a typical capacitance of 3pF and operates with no insertion loss to 1GHz.

- **Wi-Fi Antenna**
  The external antenna connects directly to the Wi-Fi PCBA on the Motherboard. Although not physically a part of the Upper Expansion PCBA, externally it is located in-line with the upper expansion panel external connectors.

Lower Expansion PCBA

The Lower Expansion PCBA is used to provide an external I/O interface between the Host module and external devices. The PCBA is mounted in the lower section of the expansion panel to support the bottom row of I/O connectors at the rear of the console.

- **Barcode Reader Interface**
  The Motherboard serial port supplies both the signal and +5V which are relayed through a 9-pin female D-sub connector to the external

Barcode Reader. The external connector was selected so that it would not be used as a normal serial port; therefore, an RS-232 cable cannot be mistakenly connected to this port. This port will only work with the Barcode Reader with a custom interface cable that has been identified for the Constellation.

Two bidirectional TVS array (SMDA15C) are used on all RS232 signal lines for ESD protection of the I/O data lines. "SMDA15C" is a bidirectional device and is designed for use on lines where the normal operating voltage is above and below ground level.

- **Tethered Laser Interface**
  Ethernet signals from the Supervisor PCBA are received through an 8-pin RJ-45 connector. This connector is used for Tethered Laser console connection only via a Cat-5 cable. The signal pin assignments of this connector were selected so that any PC connected to the system, if attempted, will not be able to communicate with, or cause any damage to, the console.

  The laser reset (LSR_RST) signal is received from the Host DC-DC Converter PCBA and routed to one of the connector pins. This connector has an internal transformer with 1.5KV dielectric withstanding capability and common mode chokes for filtering. The TVS diode arrays are used on TX+/TX-, RX+/RX- signal pairs and Laser control signals (LSR_SNS, LSR_RST) for ESD protection. The TVS device has a typical capacitance of 3pF and operates with no insertion loss to 1GHz.

- **HDD Video Recorder**
  The external Video Recorder receives its signal via a serial port from the Motherboard to the Host DC-DC Converter PCBA, which is then routed to the 9-pin male D-sub connector. This connector is basically a serial RS-232 port, and is primarily used for the external HDD video recorder.

  Two bidirectional TVS array (SMDA15C) are used on all RS232 signal lines for ESD protection of the I/O data lines. "SMDA15C" is a bidirectional device and is designed for use on lines where the normal operating voltage is above and below ground level.

- **Video Overlay**
  The Video Overlay PCBA sends two types of signals (S-Video and Comp Video). The external connectors are a 4-pin Mini-DIN connector for S-Video Out, and a 75-ohm BNC jack for Composite Out. The S-Video In and Composite Video In connectors are located on the Upper Expansion PCBA. The S-Video Out signal has its own individual connector to the Video Overlay PCBA (lower port). Although the Composite Video Out is physically located on the lower Expansion PCBA, its signal is routed through the same cable as the S-Video In and Composite Video In signals that are located in the Upper Expansion Panel PCBA.

  The two TVS diode arrays are used on these video signals for ESD protection. The TVS device has a typical capacitance of 3pF and operates with no insertion loss to 1GHz.

- **MP3 Audio**
  The Lower Expansion PCBA receives MP3 audio signal inputs through a 3.5mm stereo jack from an external audio player. These signals are then routed to the Motherboard's Audio In connector on the rear I/O. The signal is routed from the Motherboard's Audio Out connector to the Host DC-DC Converter PCBA where it is amplified and sent to the two speakers.

  Two single line TVS diodes (SD05C) are used on these audio signals for ESD protection. "SD05C" is a bidirectional TVS diode with working voltage of 5volts and is used on lines where the signal polarity is above and below ground level.

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Supervisor

GENERAL DESCRIPTION

The *Constellation*® Supervisor serves as a central clearinghouse of information and real-time control for the other modules in the system. The supervisor is comprised of a number of key elements (see Figure 2-6).

Kernel

The kernel is common to all intelligent *Constellation*® modules. It includes: PowerPC microprocessor and embedded peripherals, flash memory, SDRAM, FPGA, CPLD, ADC's, and DAC's.

Ethernet Switch

All intelligent modules in the system, including the supervisor itself and host, connect through this 100BASE-TX ethernet switch IC. The host PC only communicates with the supervisor directly, while all other modules communicate only with the supervisor. The ethernet switch, although residing on the Supervisor PCBA, is more or less autonomous. Other than a software-controlled reset line, the ethernet switch does not receive any command or control from the supervisor's processor. To the ethernet switch, the supervisor processor is just another client (module).

Illuminator Interface

The supervisor directly controls the table-top Illuminator assembly. This consists of turning control lines on and off, and reading back status information.

Footswitch Interface

The supervisor directly controls the footswitch assembly. This includes not only reading treadle and button status, but providing drive current for the treadle's feedback motor.

I/V Pole Interface

The supervisor directly controls the power IV pole assembly. Unlike the footswitch, the supervisor merely sends commands and reads status from the power IV pole assembly. The supervisor does not run the motor directly; this is handled by the Power IV Pole PCB.

RS-232

The kernel portion of the supervisor provides an RS-232 port for connection to a debug terminal. This port is for development only, and is not accessible when in-system.

Module Reset Lines

The supervisor has the capability to individually reset each intelligent module. This is done at power-up and, if required, for hazard mitigation. If a module does not reset within the specified time, an advisory or warning will appear and the particular module will not be available.

Power Conditioner

The power conditioner provides current-limiting and soft-start capability to the module. During a soft-start, the host operating system remains active, but the application software and power to the modules are reset in approximately 40 seconds.

Asynchronous Serial - Power Control Serial Port

The supervisor communicates with the Power Control PCB through an opto-isolated asynchronous serial interface. The supervisor reports system temperatures to the Power Control PCB which changes system fan settings in response.

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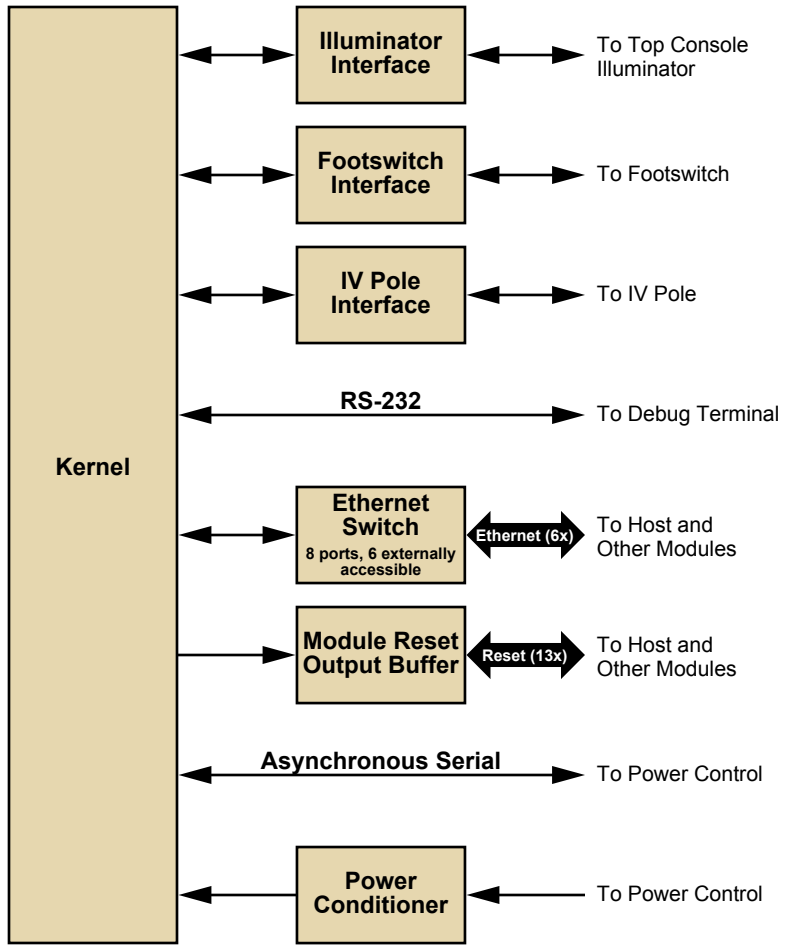


Figure 2-6 Supervisor Block Diagram

Front Panel Display

The front panel display is the main user interface of the *Constellation*® system. It has an LCD which displays the system Graphical User Interface (GUI), and a touch screen which is the primary user input device for the system.

The front panel display's major components are the display assembly and the pivot mechanism. The display can be manipulated left and right, and tilted up and down, to accommodate different user positions.

Figure 2-7 is a block diagram of the PCBAs & other electrical components used in the front panel display module, and interconnection scheme of the hardware. Figures 2-8 is a block diagram of the front panel display module communications.

Display Assembly

The primary components of the display assembly are an LCD, a touch screen, and a pair of Infrared (IR) receivers. The assembly also contains a Display Interface PCB, an SD Card Reader PCB, a Backlight Inverter PCB, and two IR Sensor PCB's. The LCD and Display Interface PCB are each connected to the host module via their own dedicated cables. Additional internal cables connect the other boards to the Display Interface PCB. Enclosures and a frame hold these components in place, and faraday shields are used to suppress radiated emissions (EMI) to and from the boards.

LCD

A 17-inch color TFT-LCD is used as the GUI display. The LCD employs an integral Cold Cathode Fluorescent Lamp (CCFL) backlight system, and is driven by LVDS display signals from the LVDS port in the host PC computer. This thin, lightweight display uses little power, and has a 17.0 inch diagonally-measured active area with SXGA resolution (1280 by 1024 pixel array).

Two power inputs are required for this LCD; one to power the LCD electronics and to drive the TFT array & liquid crystal, and a second to power the CCFL which is generated by an inverter. A 30-pin connector is used for the LVDS signal & LCD power interface. Two channels (odd / even) of pixel data signal pairs are required to drive this LCD.

Touch Screen

A 17-inch, 8-wire, resistive touch screen is mounted directly in front of the LCD. This is the primary user input device for operating the system.

Backlight Inverter PCB

The Backlight Inverter PCB receives +12 V from the host module via the Display Interface PCB and converts it to high frequency of 69-75 kHz, and up to 730 VRMS waves, to ignite and operate the LCD's CCFL lamps.

The inverter includes a dimming input that allows brightness control from either a DC voltage source

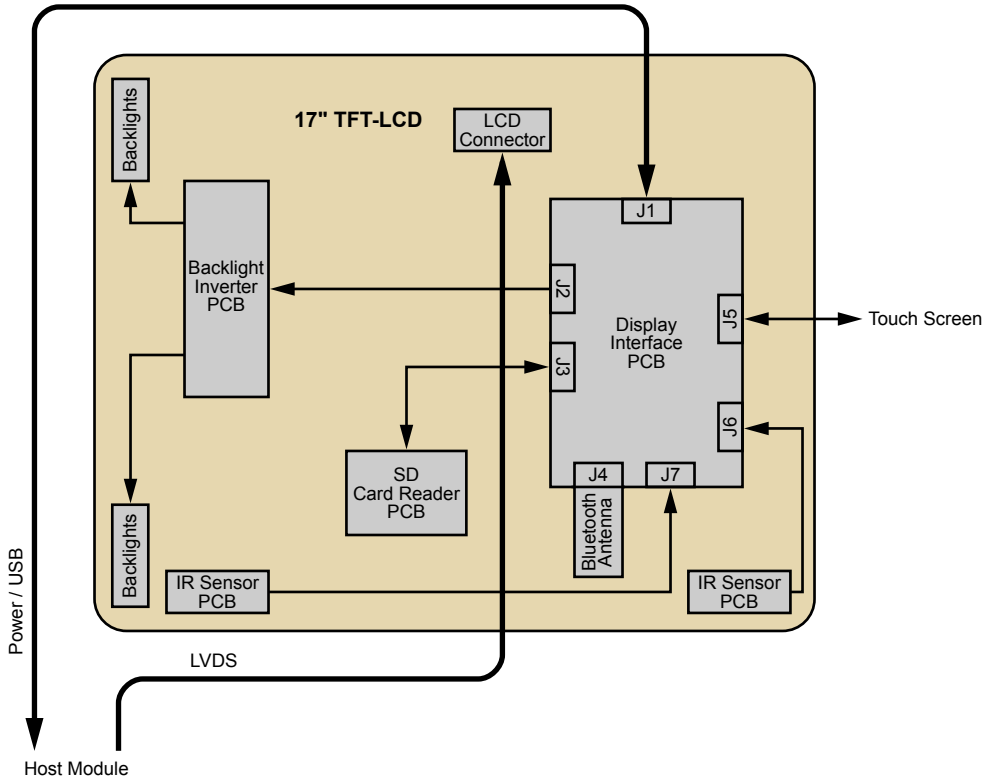


Figure 2-7 Front Panel Display Module Interconnection

or a PWM signal. The maximum output current is externally programmable over a range of 5 to 8 mA to let the inverter properly match the LCD panel lamp current specification.

Bluetooth Antenna

The Display Interface PCB provides a USB-A receptacle dedicated for a USB Bluetooth adapter connection. The Bluetooth antenna is capable of communicating with any Bluetooth-enabled device, such as the wireless headset/microphone for the system's voice activation feature.

The Bluetooth antenna supports Bluetooth 1.1 specification, and is compatible with USB 1.1. The RF-wireless frequency for this device is 2.4 GHz, and the covered range is up to 33 feet, peer-to-peer.

IR Sensor PCB

The display assembly also houses two IR Sensor PCB's and interface cables. The *Constellation®* system utilizes the same IR Sensor PCB as Alcon's *Infiniti®* system; however, the angle of the IR sensor chip has been modified to be parallel with the PCB surface. Two of these boards are mounted in the front lower corners of the display.

Display Interface PCB

The Display Interface PCB receives power, USB, and other control signals from the host module, and allocates the signals to the appropriate PCB's. It interfaces with the Backlight Inverter PCB to supply DC power (+12 V) and send backlight control signals. This board has two USB connectors; one for the SD card reader and the other for the Bluetooth antenna.

This PCB has an on-board, high-speed, USB hub controller circuit using Philips' ISP1520 device (U4). This device supports data transfer at high-speed (480 Mbit/s), full-speed (12 Mbit/s), and low-speed (1.5 Mbit/s). The upstream-facing port is connected to a USB 2.0 host, therefore the ISP1520 operates as a high-speed USB hub. The vendor ID, product ID, and string descriptors on the hub are supplied by the internal ROM. Analog over-current detection has been inhibited by connecting OC_N pins to +5 V, even though the ISP1520 supports over-current protection mode.

The touch screen control function is provided by Hampshire's HU10-100SO0 touch screen controller ASIC chip (U6). This device is a USB-based, 10-bit resolution, touch screen controller to support screen types of 4, 5 and 8 wires. Currently, the Display Interface PCB is designed to support 8-wire resistive touch screen. Transient voltage suppressors (TVS) are added to the excite lines (X+, X-, Y+, Y-) near interface connector J5 to prevent ESD damage to the IC from touching the screen.

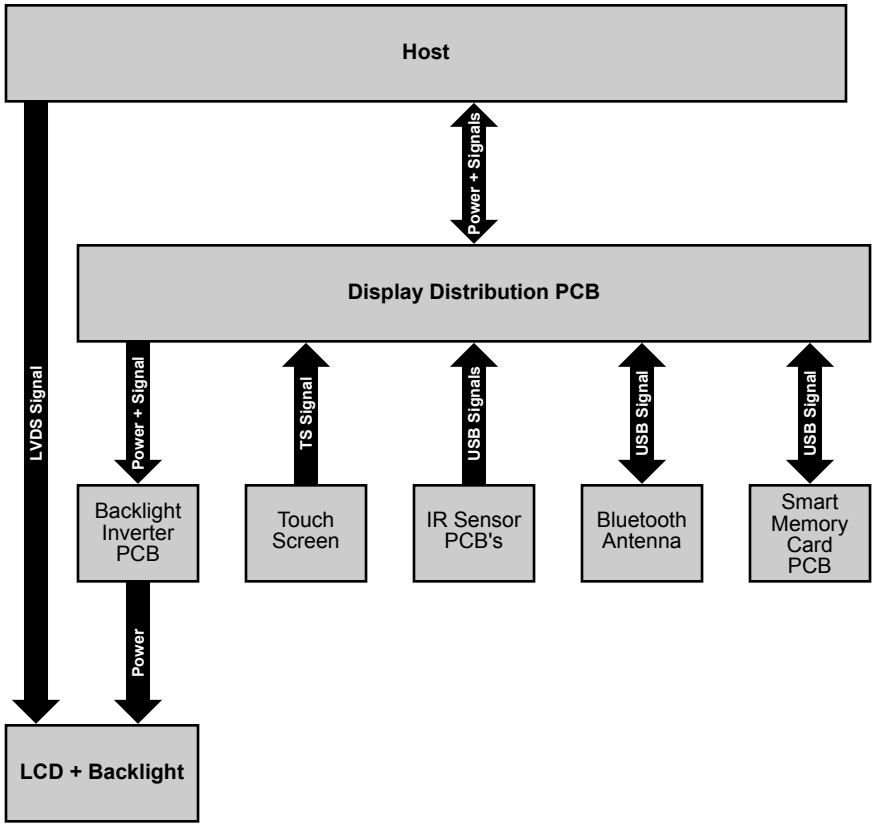


Figure 2-8 Front Panel Display Module Communications

The IR receiver circuit design on the Display Interface PCB is the same as the IR Receiver PCB design used in Alcon's *Infiniti*® system. The received pulse train of remote control transmission signal is converted into USB signals by peripheral controller device AN2131QC, and is sent to the host module.

SD Card Reader PCB
The SD Card Reader PCB interfaces with the Display Interface PCB to receive power and USB signals. There is an on-board Low Dropout (LDO) regulator circuit to generate +3.3 V from the +5 V supply.

The USB 2.0 SD card reader controller has all I/O signals to support SD1.1 flash card specification, and has built-in 2.5 V regulator output to be used as core power for the device.

The SD memory card reader is located at the bottom of the front display panel. Its connector is a reverse mount type so the card can be inserted into the slot with the label facing upward.

Shielding
Separate Faraday shield covers are used over the Display Interface PCB and the Backlight Inverter PCB to minimize radiated EMI emissions from the boards.

Operational Description

The front panel display serves several functions. It displays images processed from the host and GUI software. It houses a touch screen which acts as the primary user input device. It receives signals from the remote control, and sends these signals to the host for processing. The front panel display module provides a place for Bluetooth antenna installation, and a card slot for Secure Digital (SD) memory card reader functionality.

Display Image Processing
The host software commands that LVDS video signals to be sent from the LDVS port on the host PC motherboard to the display module. These signals travel through a dedicated LVDS cable directly to the LCD module where they are interpreted and displayed on the GUI.

Touch Screen Operation
A finger press generates analog signals from the resistive touch screen. These analog signals travel to the touch screen controller circuitry on the Display Interface PCB where they are converted into USB signals. The USB signals are then routed to the host to work in conjunction with the software to recognize the touch point to activated corresponding system parameters.

IR Receiver Operation
The IR Sensor PCB's read signals transmitted from the remote control. These signals travel to the IR receiver circuitry where they are converted into USB signals. The USB signals are then routed to the host to work in conjunction with the software to control system parameters.

SD Card Reader Operation
Data can be read from, or written to, a SD memory card placed in the slot in the lower center of the display face.

Bluetooth Antenna Operation
The Bluetooth antenna can receive signals from, or send to, any Bluetooth compatible device for the wireless communication.

Cable Routing

Primary Cabling
Two primary cables are connected from the host through the pivot arm assembly and into the display assembly. The first of these cables carries the LVDS signals from the host module directly to the LCD, and the other cable carries power, USB, and control signals from the host module to J1 on the Display Interface PCB.

Both of these cables run from the display assembly through the pivot mechanism and out to the host. The arm assembly has channels to enclose the cables, and each joint is open in the center so the cables may pass through. As the display is manipulated, and each joint is rotated, the cables must twist to follow the motion of the pivot mechanism. The cables have strain relief at the display and at the tabletop so that the twisting can be absorbed over the longest possible length of cable. Additionally, a ground strap is routed through the same path as the primary cabling, grounding the display chassis to the console chassis.

Interior Cabling
Several smaller cables carry signals from the Display Interface PCB to other PCB's in the display module. A pigtail from the touch screen is connected to the Display Interface PCB. Another pair of cables runs from the Display Interface PCB to the IR Sensor PCB's. Yet another cable connects the Display Interface PCB to the SD Card Reader PCB. • • • •

Fluidics Module

The *Constellation*® system uses a modular architecture. The Fluidics submodule is connected to the rest of the system through the 24 VDC system power bus, an ethernet connection, reset and slot ID signals, and a high pressure pneumatic air supply provided by the Pneumatics submodule.

The Fluidics submodule is comprised of two main functional blocks: the cassette and the receiver mechanism. The receiver mechanism consists of twelve functional blocks.

- Cassette Clamp Mechanism
- Cassette Valve Pincher Actuators
- Module Controller
- Non-Invasive Flow Sensor
- Infusion and Aspiration Level Sensors
- Cassette Detection Sensors
- Cassette ID Sensors
- Drain Pump
- LPAS Pump
- Infusion Subsystem
- Irrigation Subsystem
- Extraction Subsystem

These twelve blocks work together to provide the necessary infusion, irrigation, and suction functionality.

To aid in understanding the following written descriptions, block diagrams of the pneumatic system and Fluidics PCB partition are shown in Figures 2-9 through 2-14.

Cassette

The cassette provides direct control of infusion, irrigation, and aspiration fluids. It filters the air provided by the LPAS to ensure that no contamination reaches the patient during operation of pressurized infusion and irrigation functions. The cassette is a consumable assembly that contains pinch valves, flow channels, fluid chambers, a pump section, and clamping features for retention by the receiver mechanism. It will ultimately be available in several configurations; each designed to meet the specific requirements for posterior, anterior, and combined surgical case types.

The premium combined cassette is capable of providing all the functions needed to perform anterior, posterior, and combined surgeries. A drain bag attached to the cassette fills with aspirated waste fluid. The premium cassette provides fluid aspiration and pressurized fluid, filtered air, or infusion to the eye at a constant intraocular pressure independent of aspiration flow rates during posterior segment surgery. The infusion fluid source to the cassette can be changed during a procedure without interruption or re-priming the tubing from the cassette to the infusion cannula.

The Basic (gravity) and Day use cassettes provide fluid aspiration and fluid, or unfiltered air, infusion to the machine with on/off control. They do not provide pressurized infusion, IOP control, or infusion fluid source changes without re-priming.

Receiver Mechanism

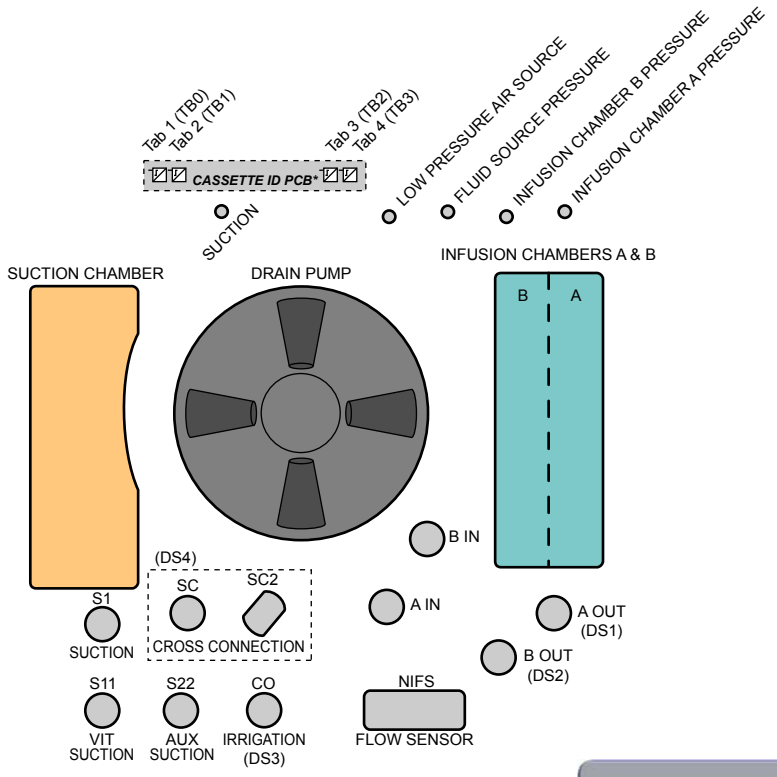
The receiver mechanism is housed in the table top console. It provides control of the cassette features listed in above. The receiver mechanism is fully functional with all cassette configurations. The functional blocks of the receiver mechanism are described below.

Cassette Clamp Mechanism

The cassette clamp mechanism retains the cassette in the receiver module during a surgical case. It consists of a pneumatic cylinder, a linkage mechanism, clamping jaws, on/off solenoid valves, and a release mechanism. The cylinder is driven by the on/off valves, which are supplied with regulated pneumatic distribution air. Together, these components provide the motion and force necessary to either clamp a cassette or release it. The release of the cassette is commanded by pushing a button on the front of the submodule, which activates an infrared optical sensor under software control. A mechanical release is available to eject the cassette when electrical power or pneumatic supply to the submodule is turned off. The Fluidics system also contains dual optical sensors for detecting cassette presence, and four optical sensors for determining the type of cassette inserted.

Cassette Valve Pincher Actuators

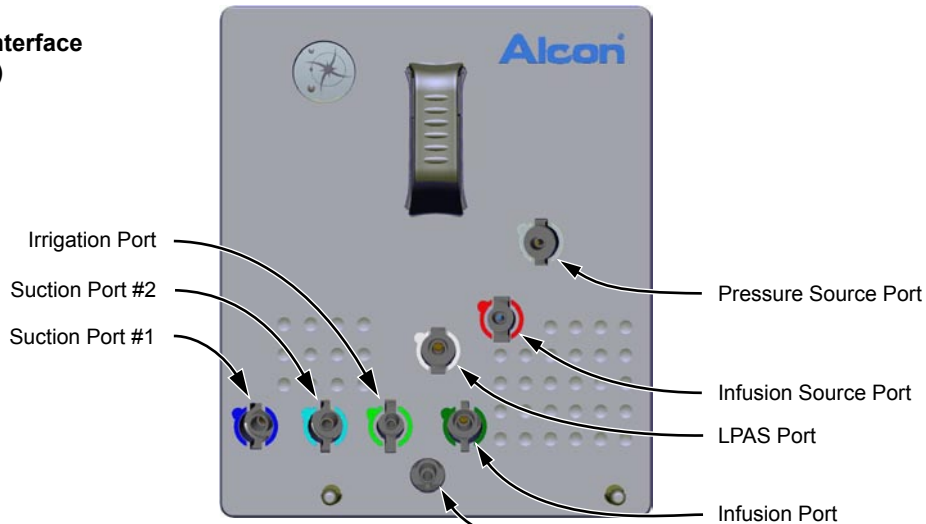
The cassette valve pincher actuators are pneumatic cylinders with special tips on the rods, which contact the valve bubbles on the rear side of the cassette. When the actuators are extended, they compress the valve bubble and close it, thus stopping flow across the valve. There are two types of actuators: a normally-retracted type, which is spring-loaded to return to the retracted position when pressure is removed, and a normally-extended type, which is spring-loaded to return to the extended position when pressure is removed. The type of actuator for each valve bubble is determined by the safe-state requirement for that



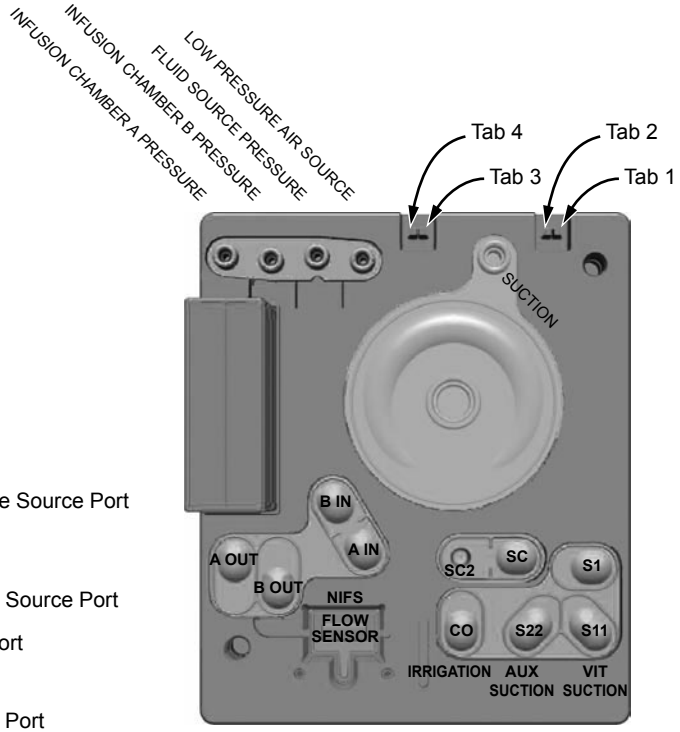
Fluidics Module Interface (front view)

COMPONENT DESCRIPTION

TYPE	NUMBER	FUNCTION	LOCATION	LAST USED
AC = ACCUMULATOR	1	F = FLOW	A[I][O] = INFUSION CIRCUIT A [IN][OUT]	AC4
CV = CHECK VALVE	2	I = ISOLATION	B[I][O] = INFUSION CIRCUIT B [IN][OUT]	CV1
CY = CYLINDER	3	IN = INTAKE	BA = INFUSION BACKUP	CY12
DS = INTERRUPT SENSOR	ETC	L = LEVEL	CO = IRRIGATION	DS7
ES = HALL EFFECT SENSOR		P = PRESSURE	C[L][U][R] = CASSETTE [LWR][UPR][RELEASE]	ES1
L = SOLENOID VALVE		S = POSITION	D = DRAIN PUMP	L20
MF = MUFFLER		V = VENT	E = SOURCE PRESSURIZATION	MF2
MT = MEASURING TRANSDUCER			F = F/AX	MT12
P = PUMP			I = INFUSION SUPPLY	P2
PV = PROPORTIONAL VALVE			L[O][C] = LATCH [OPEN][CLOSED]	PV9
RG = REGULATOR			N = NIFS	RG5
RO = RESTRICTIVE ORIFICE			P = PINCHER SUPPLY	RO2
RV = RELIEF VALVE			R = REFLUX	RV3
T = TUBING			S = SUCTION	T7
TP = TEST POINT			SC = CROSS CONNECTION	TP5
V = VENTURI			SY = SYSTEM SUPPLY	V1



Cassette (front view)



Cassette (rear view)

Figure 2-9 – Fluidics Faceplate Interface

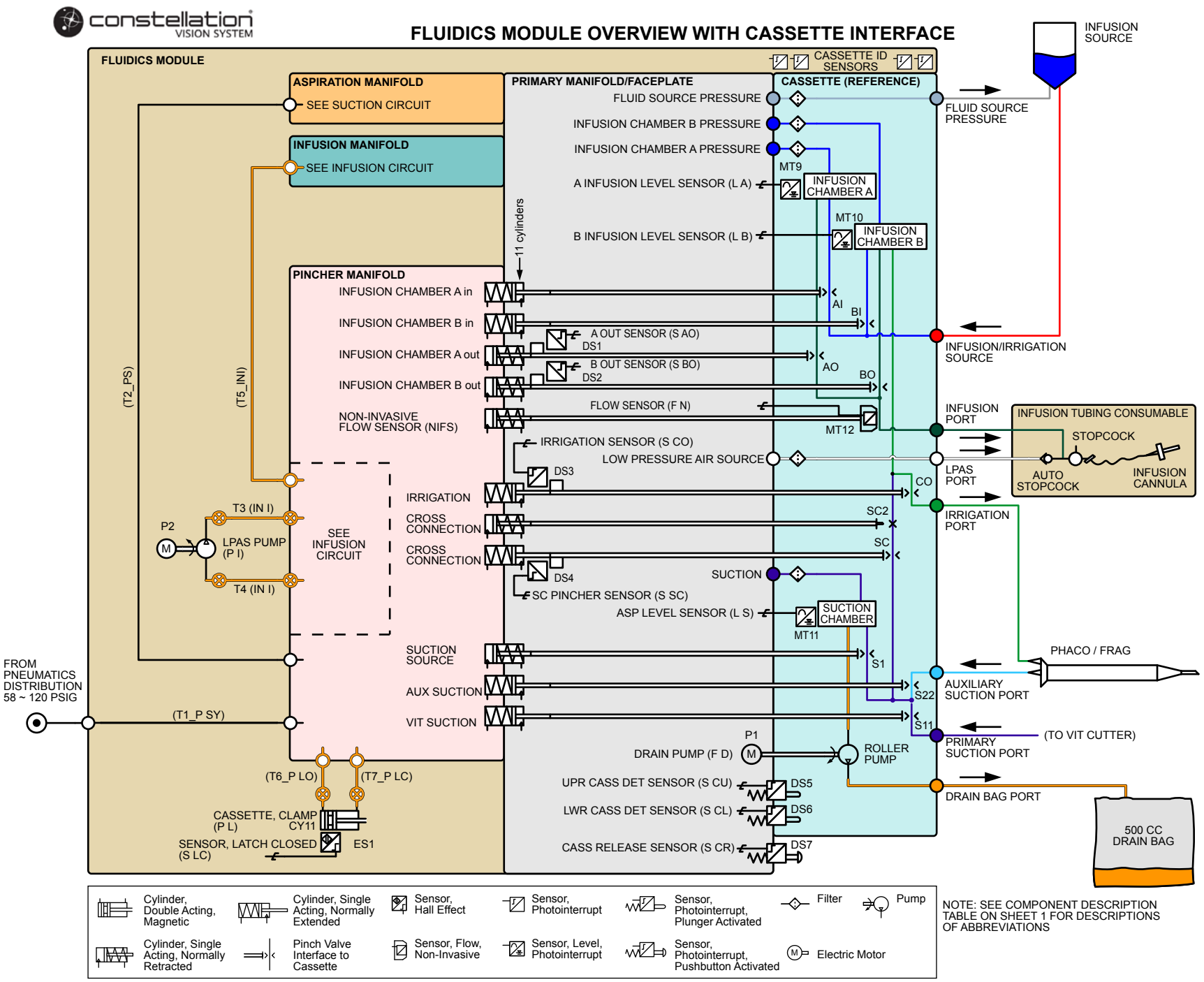


Figure 2-10 – Fluidics External Connections

INFUSION CIRCUIT

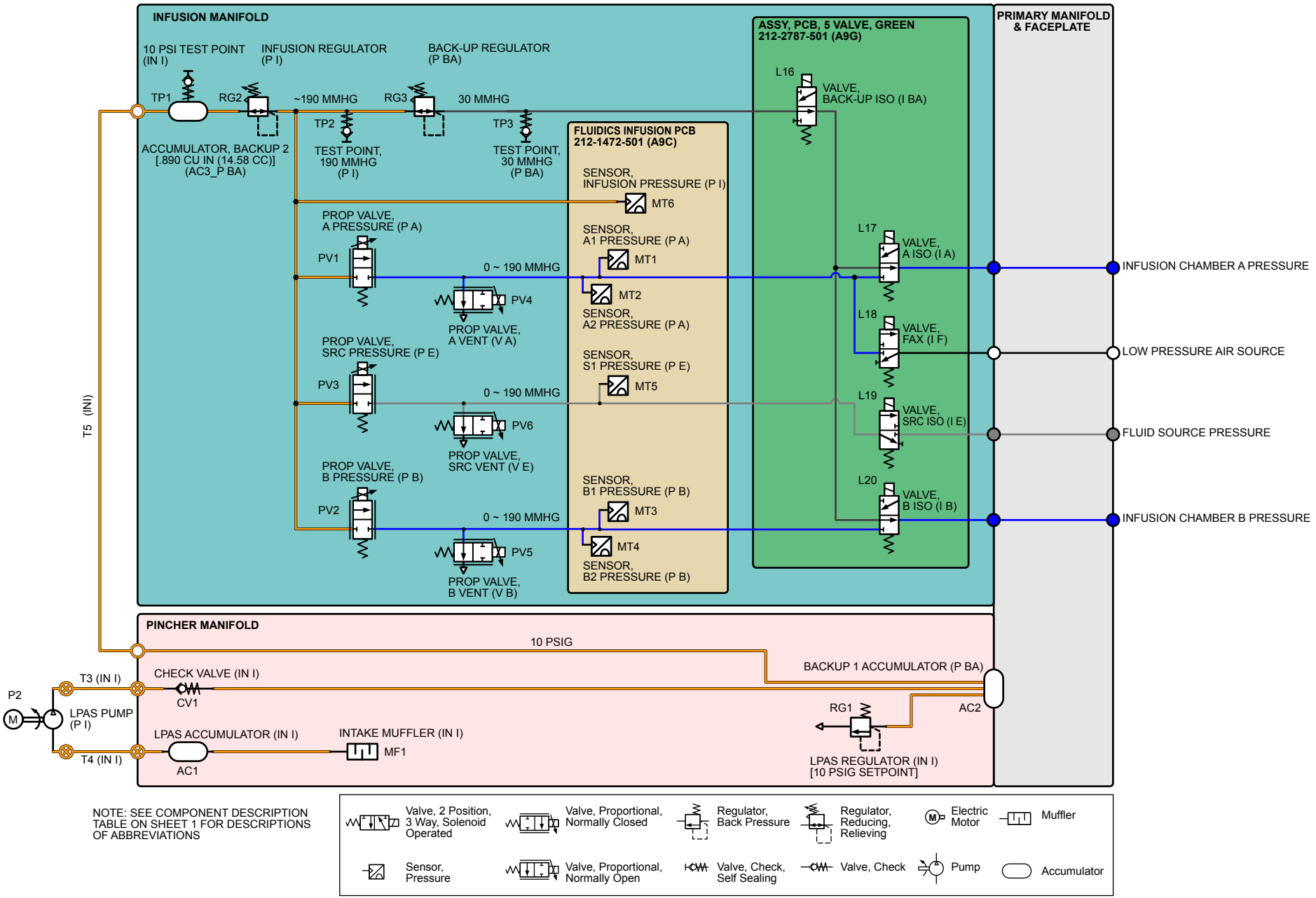


Figure 2-11 – Fluidics Infusion Circuit

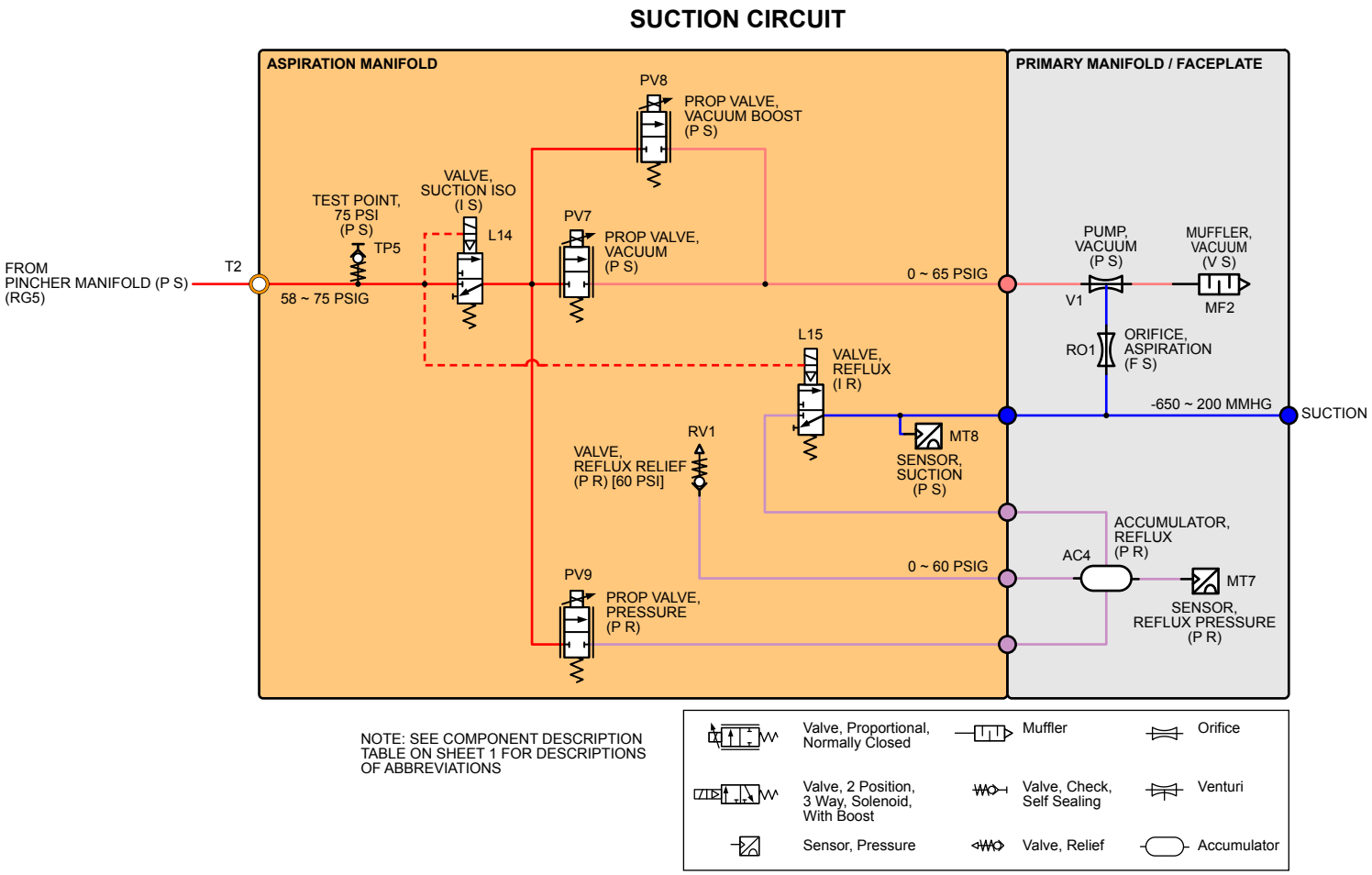


Figure 2-12 – Fluidics Aspiration Circuit

PINCHER CIRCUIT

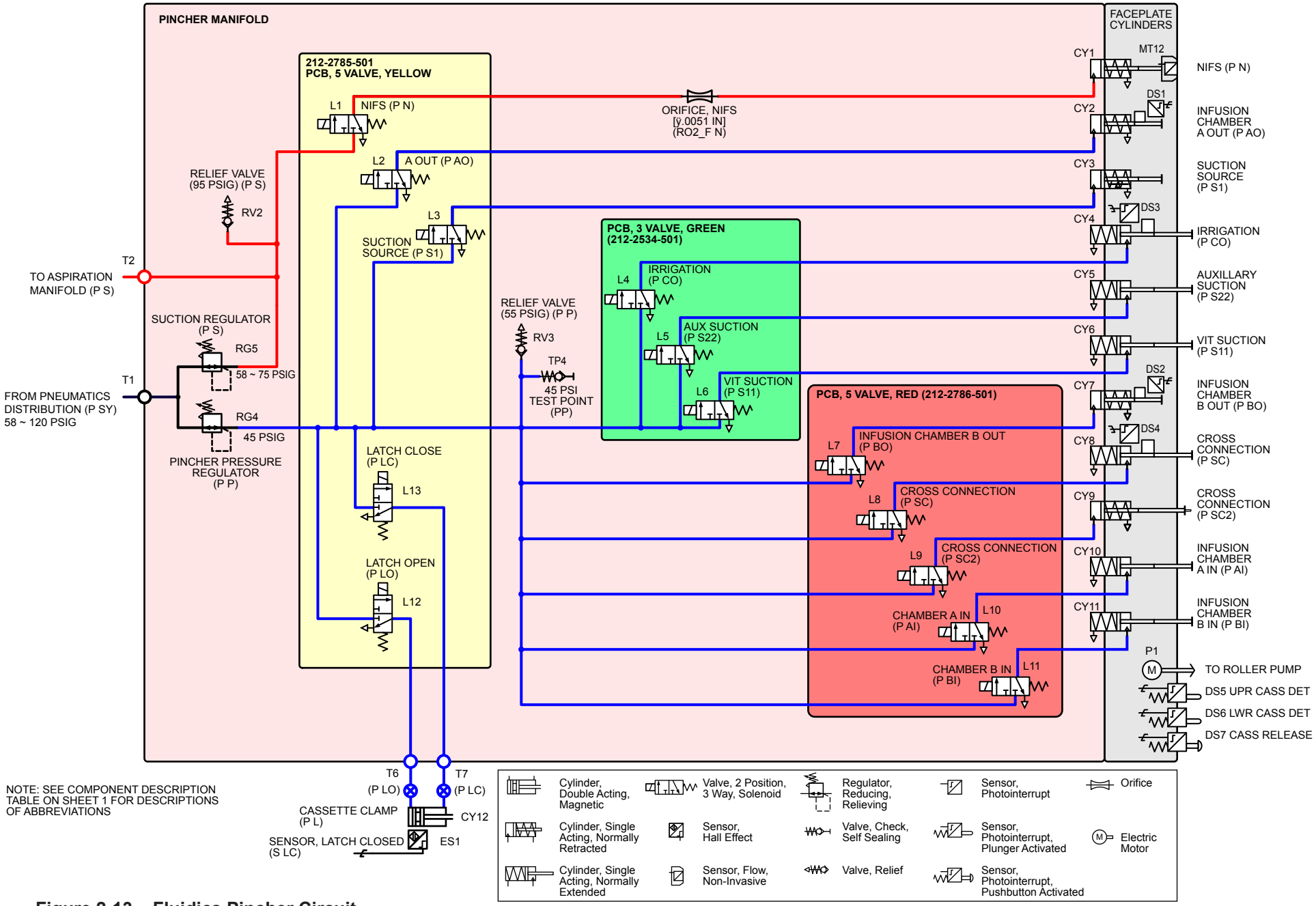


Figure 2-13 – Fluidics Pincher Circuit

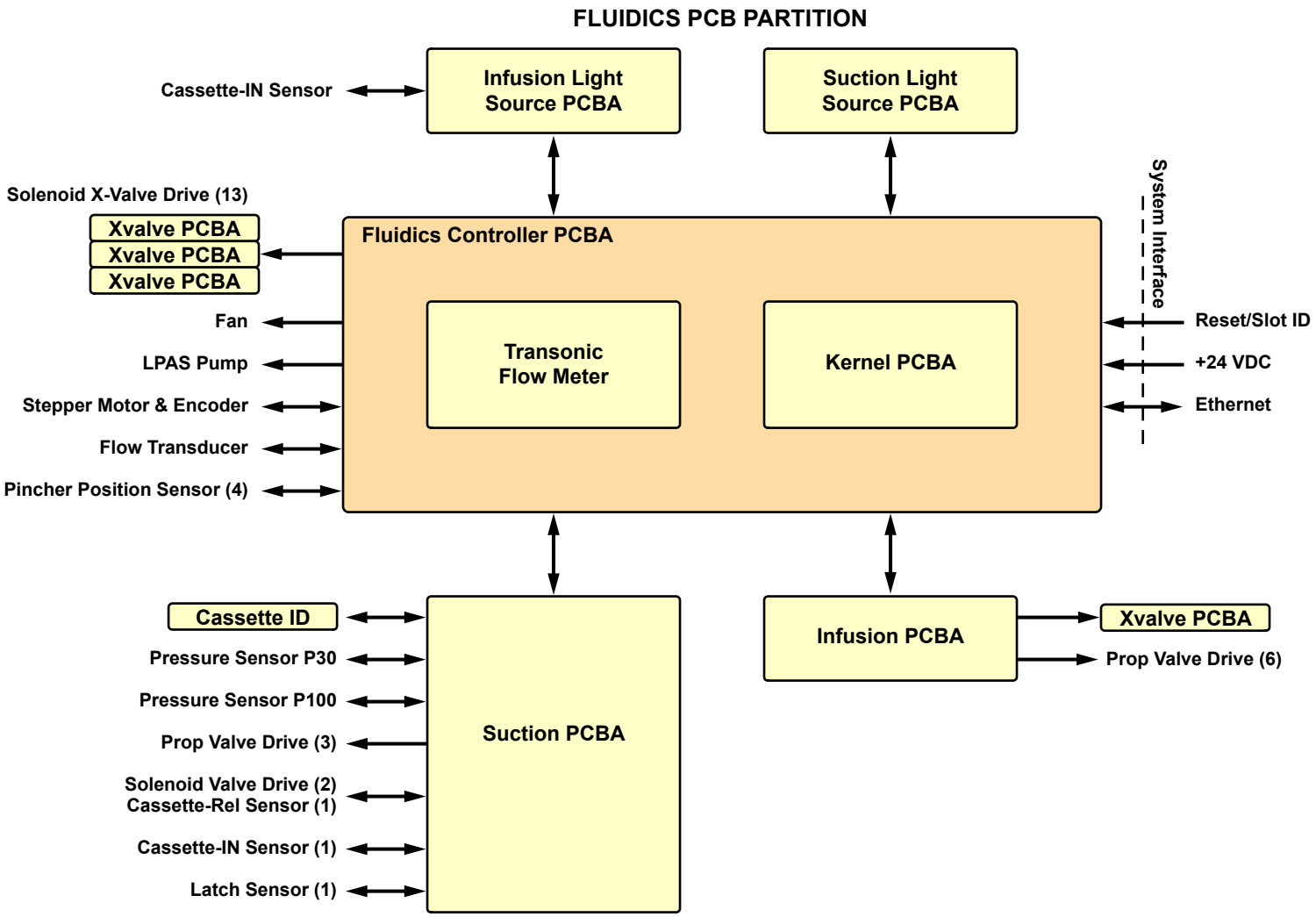


Figure 2-14 – Fluidics PCB Partition

cassette pinch valve bubble. A special type of normally-retracted pincher is used for the cross-connect (normally closed) valve actuator; it has a smaller head diameter so that it can actuate inside the special cassette valve in this location. The actuators are driven by on/off valves, which are supplied with regulated pneumatic distribution air. Valve actuators that have been determined to be critical for safe operation of the submodule are equipped with optical position sensors. The circuitry for these sensors is located on the Fluidics Controller PCB. The driver electronics for all other actuators are equipped with current feedback circuits which allow the software to verify the state of each one of the actuators' drive solenoids.

Module Controller

The module controller is made up of three circuit board assemblies: the Kernel board, the Fluidics Controller board, and the Flow Controller board.

The hardware on the Kernel board is common to all *Constellation*® submodules. It consists of an MPC8270 processor, DRAM and Flash memory, Ethernet and serial communication drivers, an FPGA with common and Fluidics specific logicware, and a number of ADC, DAC, and PWM channels. Flash memory on the Kernel board contains a small boot loader program responsible for downloading the fluidics application program from the Host module during system startup. The application program is downloaded into, and executed out of, DRAM memory.

The Fluidics Controller board provides the necessary interface and drive signals to support the main Fluidics module functions, such as the interface to the level sensors, proportional valve drivers, solenoid valve drivers, stepper motor drivers, and cassette interface control signals. It also physically interconnects with the Kernel PCB and the Flow Sensor PCB.

The Flow Sensor PCB utilizes ultrasound technology to measure the flow rate of *BSS*® irrigating fluid out of the infusion port on the cassette. The board is connected through a cable to the actual ultrasonic transducers. It receives commands from the Kernel board via one of the MPC8270 processor's serial communication channels. The serial channel is running at 115200 baud to allow for flow measurements to be received from the Flow Sensor PCB at a maximum rate of 1 KHz.

Non Invasive Flow Sensor

The Non Invasive Flow Sensor (NIFS) is a discrete element capable of measuring the flow velocity in a special section of the cassette's infusion flow channel. The sensor contains a pair of piezo-electric crystals. One crystal emits an ultrasound sound signal while the other receives the signal. The two crystals alternate between emitting and receiving. As the ultrasound beam traverses the flow channel, each ray undergoes a measurable phase shift proportional to the average velocity of the infusion flow. The Flow Sensor PCB converts the measured phase shift into a volume flow rate.

When a cassette supporting infusion flow measurements is inserted, the NIFS is moved from its location inside the receiver mechanism out into contact with an elastomeric patch on the cassette; the patch acoustically couples the sensor with the flow channel. During the infusion calibration routine, readings from the infusion pressure and NIFS sensors are combined to characterize the flow resistance in the cassette, tubing set, and infusion cannula. The equation for the acquired flow rate vs. pressure drop curve is then used in the intraocular pressure (IOP) control scheme, where the IOP is equal to the infusion pressure in the submodule minus the pressure drop in the infusion tubing set and infusion cannula at the currently-measured infusion flow rate.

When no cassette is inserted, the NIFS is retracted back into the receiver mechanism to prevent accidental damage to the sensor's sensitive parts.

Infusion and Extraction Level Sensors

The infusion and aspiration circuits contain chambers in the cassette which are used as reservoirs for the liquid flow demands of each circuit. The level of liquid in each chamber must be known during system operation, since it is these chambers which supply the liquid used during the case (infusion) and store the aspirated fluid (aspiration). The infusion and aspiration circuits provide continuous optical sensing of the liquid levels in the chambers. The level sensor consists of an array of sensing elements that are vertically aligned with the chamber. The liquid inside the chamber blocks the source light from reaching the portions of the sensing elements below the fluid level.

Cassette Detection Sensors

Two mechanisms utilizing optical interrupt sensors are used to sense the position of the cassette relative to the receiver. When the cassette is properly installed into the receiver, the optical sensors are tripped, signaling the software to close the cassette-clamping mechanism.

Cassette ID Sensors

Four optical sensors are located on the Cassette ID PCB mounted on the face of the receiver mechanism. The sensors interface with the plastic tabs on the rear of the cassette. If a plastic tab is present, the IR transmission is deflected and does not reach the corresponding optical sensor. The particular combination of tabs present on a cassette allows the system to identify it for appropriate use in the *Constellation*® system.

Drain Pump

When a cassette is inserted into the receiver, the roller-type drain pump makes forceful contact with the cassette's elastomeric pump section. Rotating the pump causes fluid in the aspiration chamber to be pumped into the drain bag. The design of the pump ensures that the flow rate is directly proportional to the pump rotation speed, while minimizing pulsations associated with peristalsis.

Low Pressure Air Source Pump

The Low Pressure Air Source (LPAS) pump supplies low pressure air to the infusion subsystem. It consists of a positive displacement air pump, an intake accumulator (for quiet operation), a filter/muffler, an accumulator (an air reservoir to supply LPAS under fault conditions), a mechanical regulator set to 196 mmHg, and one pressure sensor to monitor the mechanical regulator output. The pump is used to provide pressurized and filtered air (not nitrogen) for infusion of liquid or air into the eye at a safe pressure level (there is no connection to pneumatic distribution pressure). The integrity of the pressure sensor is checked during setup.

Infusion Subsystem

The infusion subsystem utilizes LPAS pump-supplied air to provide controlled infusion pressure. It consists of three separate circuits. The first two are active infusion circuits; one supplies the cassette's infusion chamber A, and the other supplies infusion chamber B. Infusion circuit B can be used as a redundant infusion circuit or as an irrigation circuit as required by certain case types. The third circuit is the infusion back-up circuit, intended for use when a failure occurs such that neither circuit A nor B can provide pressure to support infusion.

Infusion circuit A includes the components listed below. Together with the module controller, these components control the pressure and flow in infusion circuit A.

- a normally-closed proportional valve which is used to regulate the flow of incoming air.
- a normally-open proportional valve which is used for venting the circuit to atmosphere
- two redundant pressure sensors which sense the pressure in the infusion circuit
- a three way valve used to divert pressurized infusion circuit A air into the F/AX circuit
- a three way valve used to allow 30 mmHg infusion backup air or infusion circuit A air into cassette infusion chamber A.

Similar to infusion circuit A, infusion circuit B includes the components listed next. Together with the module controller, these components control the pressure and flow in infusion circuit B.

- a normally-closed proportional valve which is used to regulate the flow of incoming air
- a normally-open proportional valve which is used for venting the circuit to atmosphere
- two redundant pressure sensors which sense the pressure in infusion circuit B, and
- a three way valve used to direct 30 mmHg infusion backup air into the circuit.

The infusion backup circuit is directly connected to the LPAS supply. The backup circuit includes a mechanical regulator set at 30 mmHg and a normally-open solenoid isolation valve. The infusion backup circuit is connected downstream to the normally-open ports on the three-way FA/X valve in infusion circuit A and the isolation valve in infusion circuit B. When either infusion circuit A or B fails, the normally open isolation valve will open, and the three-way valves will shuttle to the normally-open position, thus allowing the 30 mmHg back-up infusion pressure to reach infusion chambers A and B on the cassette.

Source Pressure Subsystem

The source pressure subsystem utilizes LPAS pump-supplied air to provide controlled pressure for the *BSS*® fluidics bottle. It includes the components listed below. Together with the module controller, these components control the pressure and flow in the source pressure circuit. The integrity of the pressure sensor is checked during setup.

- a normally-closed proportional valve used to regulate the flow of incoming air.
- a normally-open proportional valve used to vent the circuit to atmosphere.
- one pressure sensor which senses the pressure in the circuit.
- a three way valve used to isolate the circuit from the port connection to the cassette.

Extraction Subsystem

The extraction subsystem utilizes the pneumatic distribution supply to provide controlled vacuum

or pressure to the extraction circuit. It consists of the components listed below. Together with the module controller, these components are used to control the pressure, vacuum, and flow in the extraction circuit.

- a pressure regulator which regulates the maximum supply pressure to the circuit.
- a normally closed shut off valve which is used to shut off the supply air to the circuit.
- two normally closed proportional valves which supply air to a vacuum generator.
- a venturi vacuum generator which provides vacuum to the circuit.
- an orifice on the vacuum output of the generator which is used to choke the occasional reverse flow through the generator.
- a normally-closed proportional valve which is used to charge a receiver for generating proportional pressure and impulse reflux.
- a receiver.
- two pressure sensors.
- a pressure relief valve which is used to limit the maximum pressure in the receiver during reflux.
- a normally closed shut off valve which is used to charge the extraction circuit from the receiver.

Operational Description

The operation of the different functions supported by the Fluidics submodule is described in this section.

Cassette Insertion and Removal

The two cassette presence sensors are continuously monitored during operation of the system. When both sensor signals indicate that a cassette is inserted (after having been properly debounced) the cassette is locked in place by activating the Latch Close valve and turning off the Latch Open valve. Software monitors the Hall Effect sensor mounted on the latching mechanism to make sure the latch completely reaches its locked position.

After the cassette has been locked in place, the cassette type is identified by reading the analog outputs of four cassette ID sensors. Each ID sensor has an IR transmitter and receiver. The IR transmitters are turned on one at a time to avoid cross-talk between the receivers. The outputs of the ID sensors are connected to four ADC channels on the Kernel PCB. Software reads the analog voltages generated by the sensors and compares them against a threshold value for determining whether or not a tab is present in each one of the sensor locations.

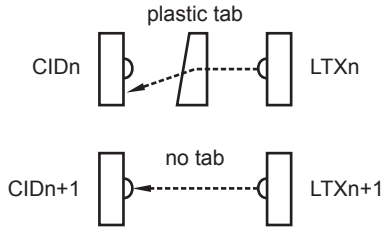


Figure 2-15 - Cassette ID Detection

If the cassette is identified as being compatible with the Non-Invasive Flow Sensor (NIFS), the NIFS actuator valve is turned on to move the NIFS in contact with the elastomeric flow sensor patch on the cassette.

When pressed, the cassette release button on top of the receiver mechanism triggers the cassette release optical sensor. When software detects that the cassette release button has been depressed, an ethernet message is transmitted by the fluidics software to the supervisor subsystem to get an approval to release the cassette. If the current operating state of the machine allows for the cassette to be removed, the supervisor in turn issues a command back to the fluidics subsystem to release the cassette. At this point the NIFS actuator and all pincher valves are retracted, after which the Latch Close valve is turned off and the Latch Open valve is activated to move the cassette clamping mechanism to the open position.

Extraction

The extraction function is used to aspirate cut vitreous and lens material out of the eye. The

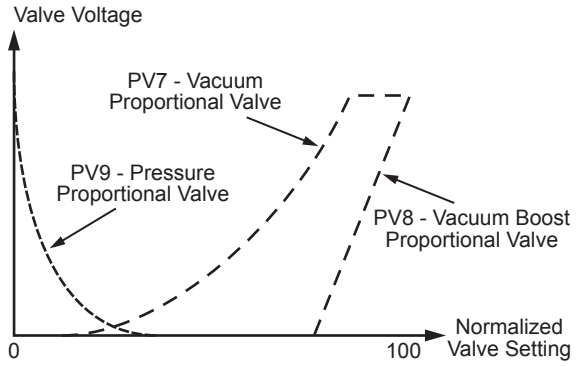


Figure 2-16 - Prop Valve Drive Voltage Mapping

extraction system is venturi based; however, since the *Constellation*® system has the ability to measure the flow of aspirated fluid, both suction and flow control modes are supported.

The fluidics submodule is capable of generating both pressure and vacuum in the extraction subsystem. Three proportional valves are used to control the pressure level in the aspiration chamber in the cassette. The fluidics software executes a control algorithm to control the pressure level in the aspiration chamber. The software reads the redundant pressure sensors and updates the drive voltages to the proportional valves every millisecond. The output of the algorithm is a normalized valve drive voltage setpoint that is mapped into an analog control voltage for each one of the three proportional valves. In this way, the algorithm simultaneously controls all three valves so the pressure level in the aspiration chamber can be varied from +150 mmHg pressure to -650 mmHg vacuum.

One of the differences between this cassette and the *Accurus*® cassette is that aspirated fluid enters the cassette from the bottom of the aspiration chamber. This design change was made to support the new flow operating modes and various reflux modalities of the *Constellation*® system. When fluid enters the chamber from the bottom, a continuous flow of fluid enters the chamber. If fluid enters from the top, drops of fluid falling into the chamber causes the fluid surface to fluctuate and disrupt flow measurements; and if air is present in the aspiration tubing set, air bubbles enter the chamber and disturb the flow measurements. In order to minimize the disturbance of air bubbles in the cassette, a plastic wall divides the aspiration chamber into two halves. Air bubbles pass through the fluid on one side of this bubble separator while flow measurements are being made on the other side. Most fluid level disturbances are damped by the presence of this plastic wall.

Suction Mode

In suction mode, the pressure in the aspiration chamber is set to the desired pressure as commanded by the user through the footswitch. The pressure in the aspiration chamber is controllable between +150 mmHg pressure and -650 mmHg vacuum. By allowing the chamber to be pressurized, and by setting the starting range of the treadle-controlled pressure to be close to the IOP, passive flow is minimized and precise control of low aspiration flows can be achieved.

Minimum and maximum flow limits are associated with the suction mode. The minimum flow limit is set to 0 cc/min to make sure regurgitation does not occur if, for some reason, the PEL is not configured correctly. The maximum flow limit is set through the user interface. If the calculated flow goes outside the range of the configured flow limits, the fluidics subsystem automatically transitions into flow control mode. The system transitions back to suction mode when the measured flow is back within the flow limit range. Hysteresis is added to the flow limits to prevent the system from oscillating back and forth between the suction and flow control mode.

Flow Mode

In flow control mode, the flow rate commanded by the user through the footswitch treadle is used as the setpoint to the algorithm that controls the pressure in the suction chamber. The actual flow rate calculated is used as the input variable to the control loop. The peristaltic drain pump is set to a speed that results in the desired flow rate with adjustments made to keep the fluid level in the cassette in the middle of the flow mode operating range. If the fluid level goes outside the flow mode operating range, accurate flow measurements can no longer be made, and flow mode is turned off.

Minimum and maximum pressure limits are associated with the flow mode. If the required pressure to achieve the desired flow rate goes outside the range of the configured pressure limits, the fluidics subsystem automatically transitions into pressure control mode. The system transitions back to flow mode when the measured pressure is back within range of the pressure limits. Hysteresis is added to the pressure limits to prevent the system from oscillating back and forth between the flow and pressure control modes.

Priming

Priming is the process of removing air from the probe and/or handpiece, connecting the aspiration tubing set to the cassette's suction ports, and priming the suction circuits within the cassette. Additionally, priming fills the aspiration chamber with enough fluid to make operating the system in flow mode possible, and to allow reflux. There are two different ways of priming: push-prime and suction prime.

Push-Prime

The push-prime sequence primes the aspiration path of a probe or handpiece that is connected to the cassette by forcing fluid from the aspiration chamber into the aspiration tubing set and the probe or handpiece. Push-priming is only used when the cassette is clean in order to prevent contaminated material from exiting the aspiration ports.

Push-priming is a two step process. First, the aspiration chamber is filled with fluid from infusion chamber B. This is accomplished by applying a vacuum in the aspiration chamber and opening the SC and SC2 valves to open the fluid path between the infusion and aspiration chambers. When a sufficient amount of fluid has entered the aspiration chamber, valves SC and SC2 are closed. Secondly, the selected aspiration port is opened and the aspiration chamber is pressurized. Fluid is pushed out of the aspiration chamber into the aspiration tubing set and the probe or handpiece. The volume of fluid pushed into the tubing set is measured by reading the change of the fluid level in the aspiration chamber. When a predefined volume of fluid has been pushed into the tubing set, the push-prime process is complete.

By utilizing push-priming instead of suction prime, the time required to prime a 25 gauge probe is greatly reduced.

Suction Prime

The suction prime sequence primes the aspiration path of a probe or handpiece that is connected to the cassette by aspirating fluid through the probe or handpiece into the aspiration chamber. The pressure level in the aspiration chamber is set to a predefined vacuum level while the fluid flow into the cassette is monitored. The prime sequence is complete when the fluid level sensor in the aspiration chamber indicates that a certain volume of fluid has entered the aspiration chamber. The prime sequence is considered to have failed if the maximum prime timeout period is exceeded.

Reflux

Reflux is the ability to reverse the direction of aspiration flow such that effluent material is pushed back out of the aspiration tip. Reflux is typically used to clear a clogged aspiration tip. Additionally, it may be used for visualization of a surgical site by "blowing" blood and other material away from a particular point of interest, or it can be used to facilitate entry of the surgical tools into the wound. Three different types of reflux are supported: micro reflux, continuous reflux, and proportional reflux.

Micro Reflux

Micro reflux is created by generating a short-duration pressure pulse at the aspiration port. To generate the pulse, this sequence is executed.

1. The reflux valve is turned off to be able to charge the reflux accumulator.
2. The reflux accumulator is charged by running the extraction control loop with a high positive-pressure setpoint, typically around 1000 mmHg.
3. When the pressure in the reflux accumulator reaches the setpoint, the proportional valve is closed and valve S11 or S22 is opened, depending on the selected aspiration port.
4. After a short delay (the delay time depends on the opening time of the aspiration port) reflux valve L15 is turned on. The pressure stored in the reflux accumulator creates a pressure pulse that travels through both the suction port and the suction orifice on the vacuum generator. The suction orifice limits the maximum pressure and duration of the pressure pulse sent through the aspiration port.
5. After a predefined timeout period, typically in the 100 mS range, the previously-opened aspiration port valve is closed.

Continuous Reflux

Continuous reflux is reflux that generates a constant fluid flow out of the aspiration tip. Continuous reflux is typically only used to "bloom" the wound site for tool insertion during anterior segment procedures. The continuous reflux function is implemented by configuring the pinchers in the receiver mechanism to route fluid from infusion chamber B through the infusion/aspiration cross-connect path out of the aspiration output port. The flow out of the aspiration port is controlled by the pressure generated in infusion chamber B.

Proportional Reflux

Proportional reflux is reflux that ranges between a low flow rate and a high flow rate depending on the footswitch treadle position. As the treadle is depressed, materials are pushed out of the aspiration line at a quicker rate. The proportional reflux function is implemented by running the extraction system in suction mode with variable pressure setpoints being transmitted down to the fluidics submodule from the supervisor module. The volume of fluid available for proportional reflux is limited to the amount of fluid present within the flow mode operating range of the aspiration chamber.

Occlusion Detection

When anterior flow mode is active, the software monitors the flow impedance for the handpiece connected to the active aspiration port. The occlusion test evaluates different aspiration vacuum and flow conditions and establishes appropriate aspiration limits for the detected conditions.

Drain Bag Volume

The fluidics application software estimates the volume of fluid transferred into the drain bag by utilizing the relationship between the pump speed and the generated flow rate. The pump efficiency relationship has been determined for a typical combination of cassette and receiver mechanism. When the estimated volume of fluid pumped into the drain bag indicates that the drain bag is full, a warning message is displayed to the operator.

Infusion

The infusion subsystem provides control of irrigation and infusion pressures during surgery. The infusion subsystem operates in single chamber or dual chamber mode depending on the type of surgery that is to be performed. With premium cassettes, pressurized infusion and irrigation are supported. With all other types of cassettes, only on/off control of infusion and irrigation are supported. The subsystem also controls infusion of air during F/AX.

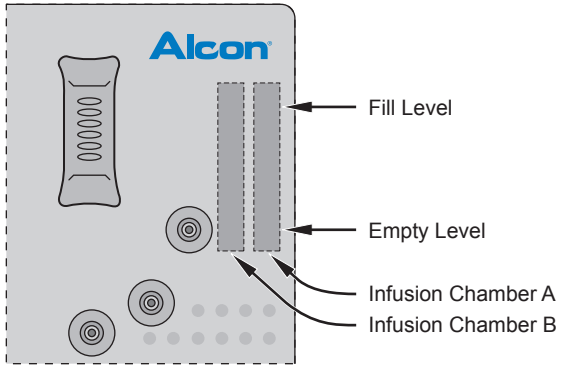


Figure 2-17 - Cassette Infusion Chambers

The infusion subsystem contains three sets of proportional pressure valves and redundant pressure sensors to generate simultaneous independent infusion, irrigation, and *BSS*® fluidics bottle pressure levels. Each pressure generator is controlled using a software algorithm.

The fluid levels in the infusion chambers of the cassette are measured using the same type of level sensors used to measure the fluid level in the aspiration chamber.

LPAS Pump

The LPAS pump provides air pressure to the infusion subsystem. The pump charges an accumulator with air to a pressure of 10 PSIG. To ensure safe operation, a pressure regulator located downstream from the accumulator limits the pressure output of the accumulator to 207 mmHg. In the case of a power loss, this volume supplies the 30 mmHg infusion backup pressure circuit with reserve air.

Dual Chamber Mode

The dual chamber infusion operating mode is used with premium cassettes during posterior cases. In dual chamber mode, control of infusion pressure is switched back and forth between the two cassette chambers. While one chamber is providing infusion pressure (“active”), the other chamber (“filling”) is being refilled with fluid from the *BSS*® fluidics bottle.

When the fluid level in the active infusion chamber reaches the Empty Level, a chamber switch is initiated. The pressure in the filling chamber (previously filled with fluid) is adjusted to the same pressure as in the active chamber. When the pressure in the filling chamber has stabilized, the output of the filling chamber is opened and the active chamber’s output is closed. The pressure in the previously active chamber is turned off and its input is opened to allow it to be refilled with *BSS*® irrigating fluid.

Software monitors the fluid level in the chamber while the chamber is being refilled. When the level reaches the Fill Level, the input valve is closed. If the chamber does not fill with fluid within a specified timeout period, or if software detects large level fluctuation in the chamber, the *BSS*® fluidics bottle is deemed to be empty and the operator is notified. The volumes in the infusion chambers were designed to allow the *BSS*® fluidics bottle to be replaced with enough reserve available in the active chamber to allow the bottle to be replaced without interrupting surgery.

Single Chamber Mode

The single chamber operating mode is used in combined and anterior surgical modes. Both infusion chambers can be active at the same time, providing independent infusion and irrigation pressures. Infusion is controlled by chamber A and irrigation is controlled from chamber B.

In single chamber mode, when the fluid level reaches the Empty Level, the input to the chamber is opened to allow the chamber to be refilled while it provides infusion or irrigation pressure. The *BSS*® fluidics bottle is pressurized to overcome the pressure in the infusion chambers. The algorithm controlling the chamber pressure compensates for the pressure inside the infusion bottle by adjusting the voltages to the proportional pressure and vent valves to not disturb the pressure delivered to the eye during the fill process. When the fluid level in the chamber reaches the Fill Level, the input valve is closed. If the chamber does not fill with fluid within a specified timeout period, or if software

detects large level fluctuation in the chamber, the *BSS*® fluidics bottle is deemed empty and the user is notified. The Empty Level is set at a higher level than in dual chamber mode to make a large enough volume of fluid available to be able to not interrupt surgery if the infusion bottle runs out of fluid and needs to be replaced.

IOP Compensation

IOP compensation is one of the key innovations with the *Constellation*® system. The IOP control algorithm compensates for the pressure drop caused by fluid flowing through the infusion tubing set to provide a constant IOP. IOP compensation is available only with premium cassettes in posterior and combined surgical modes.

Tubing Calibration

Tubing calibration is required to determine factors required for IOP compensation calculations. During calibration, the infusion cannula is placed at the same level as the cassette and the infusion pressure is ramped from 0 to a max pressure setpoint and back to 0 mmHg while flow and pressure data samples are being collected. The max calibration pressure is dependent on the gauge of the selected infusion cannula.

Priming

Before infusion and irrigation can be turned on, the infusion chambers and connected tubing sets and cannulas need to be filled with fluid.

In dual chamber mode, the following sequence of steps is executed to prime the infusion tubing:

1. AI and BI are opened to fill the infusion chambers with fluid from the *BSS*® fluidics bottle.
2. AI and BI are closed when the chambers are filled with fluid.
3. Chamber A is pressurized and AO is opened to start priming the infusion tubing.
4. Software monitors the fluid level in the infusion chambers. After a volume of fluid sufficient to prime the path between the output of chamber A and the infusion port on the cassette has flowed out of chamber A, AO is closed and the pressure in chamber A is turned off.
5. Chamber B is pressurized and BO is opened.
6. After a volume of fluid sufficient to fill the complete infusion tubing set has been transferred out of infusion chamber B, BO is closed and priming is complete.

In single chamber mode, the following sequence of steps is executed to prime the infusion and irrigation tubing:

1. AI and BI are opened to fill the infusion chambers with fluid from the *BSS*® fluidics bottle.
2. AI and BI are closed when the chambers are filled with fluid.
3. Chambers A and B are pressurized and valves AO and BO are opened to start priming the infusion and irrigation tubing sets.
4. Software monitors the fluid levels in the chambers. After a volume of fluid sufficient to fill each one of the connected tubing sets has been transferred out of the chambers, the output of the respective chamber is closed and the pressure turned off.
5. When both tubing sets have been filled with fluid, priming is complete.

***BSS*® Fluidics Bottle Pressurization**

The pressure in the *BSS*® fluidics bottle needs to be higher than the pressure in the infusion chambers in order for the chambers to be refilled while infusion and/or irrigation are turned on. The pressurization circuit is controlled by a software algorithm. The bottle is pressurized to 150 mmHg. No venting of the bottle pressure is available.

***BSS*® Fluidics Bottle Empty Detection**

During operation, with a premium cassette inserted, the system can detect when the *BSS*® fluidics bottle runs out of fluid and issue a warning to the operator. When the operator is notified, a limited reserve of infusion fluid is still available as described previously, allowing surgery to continue while the bottle is being replaced. Additionally, while operating in a posterior surgical mode with a premium cassette, the system keeps track of the volume of fluid remaining in the bottle. When an estimated 50 cc of fluid is left in the bottle, a near empty warning is issued.

Level Sensing

The fluid level sensors utilize 512-pixel linear sensor arrays. The individual sensing elements are spaced 0.005'' apart. They provide optical sensing of the liquid levels in the chambers due to the difference between the liquid vs. air effective transmission of the source light which travels through the chambers. The maximum level sensor reading acquisition rate is 1 KHz. The logicware in the FPGA on the Kernel board generates the clock signals which shift out the captured analog light intensity readings of each pixel element. The logicware converts the analog pixel signals into digital values, processes the values, and compares the results against a programmed fluid detection

threshold value. A digital level reading is then presented to the fluidics application software.

The source light to the sensors is generated by two banks of seven LED's. If one bank of LED's fails, the other bank will still provide sufficient light for fluid level readings to continue, but at a reduced level of functionality.

Calibration

The gain of each sensor element within each level sensor is not identical. In order to compensate for this variation, the logicware in the Fluidics FPGA applies a different gain value to each pixel element. After a cassette has been inserted, the software performs a calibration of the level sensors. During calibration, the logicware stores ADC readings from all 512 pixel elements into a memory area in the FPGA, the value for each pixel element being an average of multiple level sensor readings. The fluidics software retrieves the ADC readings and calculates the required gain for each pixel to eliminate sensitivity discontinuity among pixel elements. The resulting gain profile is written back to the FPGA. The gain profile is used by the logicware to adjust the output of each pixel element.

High Resolution Mode

The level sensor is capable of operating in a high resolution mode in which fractional, sub-pixel fluid level information can be acquired. In this mode, the FPGA logicware captures a full frame of 512 pixel intensity readings into a memory array in the FPGA each time a fluid level reading is performed. The logicware compares the captured values against the programmed fluid detection threshold value and returns the pixel location that is closest to this value to the fluidics software. The fluidics software then reads back the intensity values of the pixels surrounding the triggered pixel location from the FPGA memory array and, by utilizing an interpolation algorithm, uses these values to calculate a high resolution fluid level. Specifically, this high resolution mode is used in extraction flow control mode to be able to accurately calculate the aspiration flow.

• • • •

Pneumatic and Air Distribution Module

The Air Distribution Module provides the Pneumatics and Fluidics Modules with compressed air or nitrogen (N2) gas. The Pneumatics Module provides the required signal to run various pneumatic instruments.

The Pneumatics Module serves several functions. It delivers proportional pressure/vacuum and pulsed fix pressure. It also provides a method to select and deliver a specific gas to a specific consumable.

Air/Gas Distribution Module

The compressed air/gas (nitrogen) is delivered from either source of pressure through the inlet hose to the console. The compressed air/gas is routed through a channel/tube with an online pressure transducer and pressure relief valve. At this point the inlet pressure is monitored to ensure pressure is within a specified range. If inlet pressure is within the specified range, the isolation valve is commanded to open automatically and allow the compressed air/gas to go through, but if inlet pressure is below minimum or above maximum requirements, the operator is advised and it will not open the isolation valve.

If inlet pressure is within the specified range, air/gas is sent through a filter/moisture separator and on to a second transducer. These two transducers read the dynamic pressure differential across the filter/moisture separator to determine filter service intervals and filter status.

Pneumatics Module

The Pneumatics Module consists of two combined independent reservoirs which provide a means to store energy. The stored energy is used to generate proportional and fixed pressures. These pressures are controlled dynamically via a close loop. The main manifold assembly contains a series of sub-manifolds in which there are valves, transducers, cables, PCBA's, and connectors to support all the components within the assembly.

Dynamic Pressure Control Systems
The pneumatic manifold has two built-in reservoirs which allow two dynamic pressure control systems to operate independently from each other. The proportional valves, together with the transducers and software/PID loop, control the pressure generated by these two independent pressure control systems. Any pressure set point is generated by a constant communication between the proportional valve and the transducer. The resultant pressure is sent through the appropriate channel to the dedicated control valve. This valve is either open or pulsed, and the pressure is then routed to the dedicated console connector.

- The 58 (psig) Sub-System
  The system provides proportional and fixed pressure for the vitrectomy probe (dual acting) and pneumatic scissors. These devices share the same dynamically-variable pressure control system, but do not share the same pneumatic port connectors.

  Vitrectomy probes have specific pneumatic requirements. The system generates the required pressure and pulses to run the probes correctly.

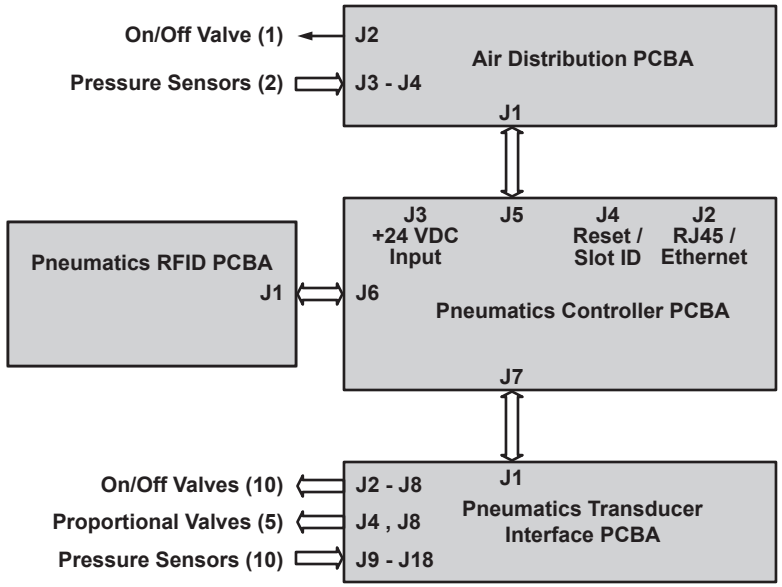


Figure 2-18 Pneumatics and Air Distribution - This figure shows a physical block diagram of the PCBAs and their interconnectivity.

The main manifold provides two ports with different genders to connect and run vitrectomy probes.

Scissors pressure requirements are generated by the same variable pressure and proportional/ pulsed pressure control system, but are delivered through a different single port. It provides all the required proportional and pulse pressures.

- The 80 (psig) Sub-System
  The system provides proportional and fixed pressure for forceps, shear cutters, viscous fluid control (inject/extract), and auto gas filling.

  Forceps pressure requirements are generated by the variable proportional pressure control system, but are delivered through a different single port.

  Shear cutter requirements are generated by the variable proportional pressure control system, but are delivered through a different single port.

  VFC requirements are generated by the variable proportional pressure/ vacuum control system, but are delivered through a different single port. This port provides pressure and vacuum for VFC injection and extraction.

  Auto Gas Filling (AGF) pressure requirements are generated by the same variable proportional pressure control system, but are delivered through a specific and unique dual/coax port. The delivery system for the gases (C3F8 and SF6) is routed through specific circuits that allow pressure control and selected gas to be delivered to the consumable.

Pneumatic Module Functionalities

- *UltraVit*® Probe High Speed Cutter
  UltraVit® probes require a dual-alternating-pressure signal in order to function. To achieve this requirement the Pneumatic Module has a set of valves strategically located and routed to provide a dual-output pressure. This dual-output pressure is routed to male and female pneumatic connectors located on front of the module. When the operator selects vit cutting, an electric signal, and a set point pressure (psig) is sent to a 3-way isolation valve; this isolation valve is command to open. At the same time, a second pulsed-electrical-signal (PWM) is sent to a 4-way valve to generate a variable-speed pulsed-dual-output pressure signal to the console dedicated connectors.

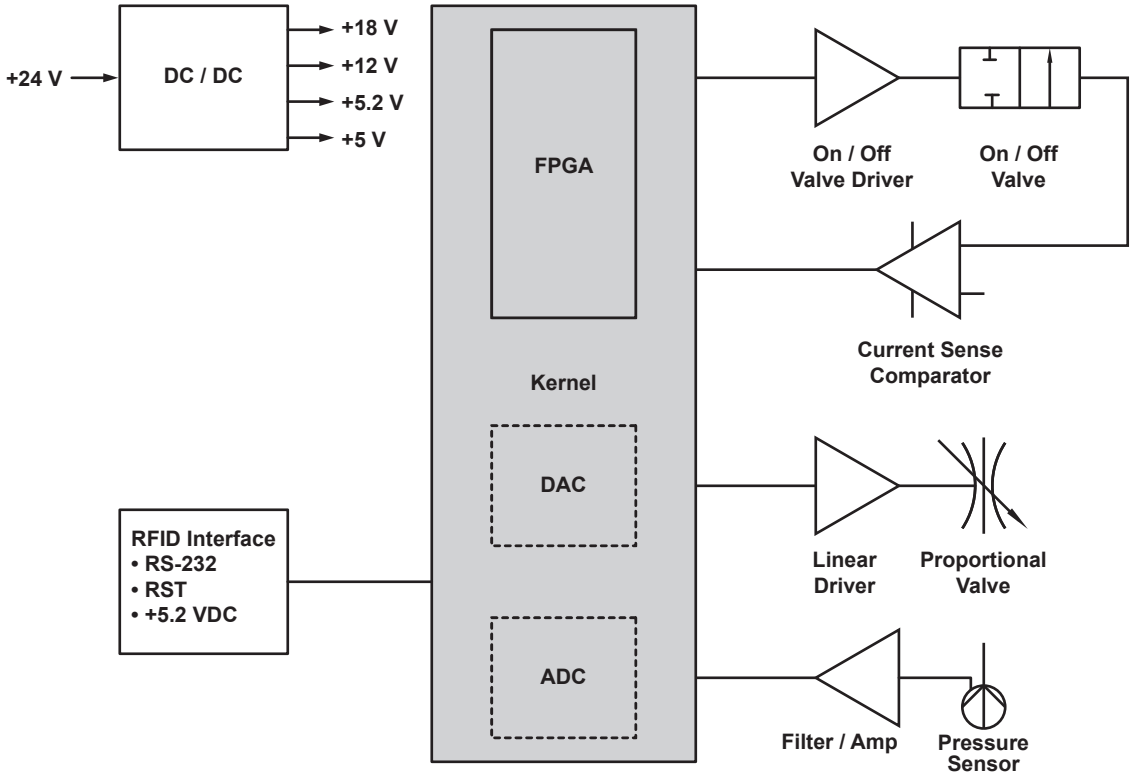


Figure 2-19 Pneumatics Electronics Hardware - This figure shows a functional block diagram of the Pneumatics Module electronics hardware.

- Scissors and Forceps (fixed or multi-cut)
  Commanded by the operator, and directed by software, an electrical signal and a set point pressure (psig) are sent to a control valve. This is delivered and commands the valve to open. If this takes place, the compressed air/gas coming out of the appropriate console connector is fixed or proportional depending on operator input. On the other hand, if the signal to the control valve is PWM, the valve is pulsed, and the connector at the console delivers a pulsed pressure.

- Viscous Fluid Controller (inject or extract)
  VFC is required to generate proportional pressure and proportional vacuum. To achieve this, the system uses the proportional pressure control system. This pressure is routed through the manifold to the appropriate valve. If this valve is open, proportional or fixed pressure is delivered to the appropriate connector on the console. If vacuum is required, the same pressure control system delivers pressure to a different valve. These valves redirect the pressure to a vacuum generator. Vacuum is routed to another valve that delivers vacuum to the common console connector.

- Auto Gas Filling (AGF)
  AGF requires two different gases (SF6 or C3F8, one at a time) to be routed through the main manifold and delivered to a consumable (i.e., syringe). When the AGF functionality is selected by the operator, an air pressure signal is delivered to the back of the syringe, forcing the syringe plunger to move forward to the front end of the stroke. The next cycle directs the selected gas to enter the manifold and travel through a pressure regulator and a set of redundant transducers. The regulator adjusts the selected gas pressure to a maximum of 10 PSIG; the inline transducers confirm the pressure set point. The selected gas is then delivered to the syringe. The pressure of the gas forces the plunger to move back to the end of the stroke of the syringe.

  At this point the system has completed a full stroke of the syringe, but it is necessary to purge the syringe of the air mixed with gas. Compressed air pressure is routed one more time to the back of the syringe, this pressure forces the plunger to the forward end of the its stroke and the pre-loaded gas is forced to evacuate the syringe via a set of check valves. The next step allows gas to enter and fill the front of the syringe while allowing the back to exhaust to atmospheric pressure. At this point the system has completed a second full cycle, the syringe is full of gas at the required gas concentration, and is at a preset pressure (no mixing).

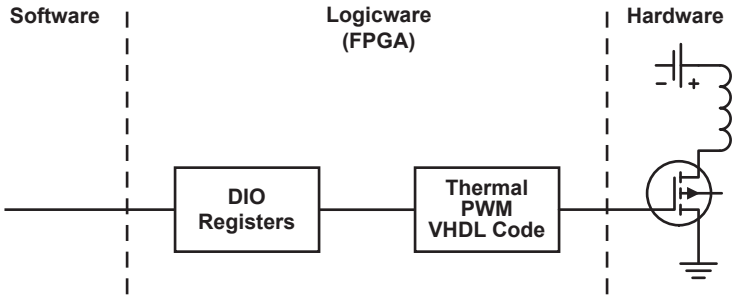


Figure 2-20 **On / Off Valve Driver - This figure shows the partition of software, logicware, and hardware that drive the on/off and drive/control proportional valves.**

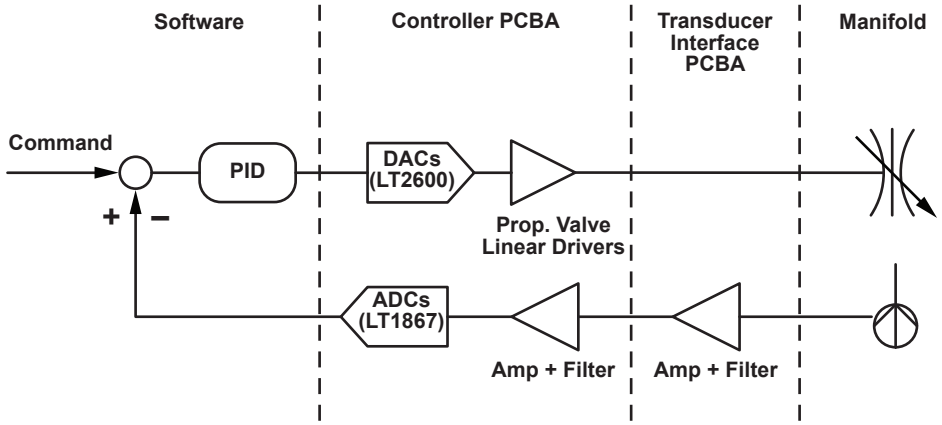


Figure 2-21 **Pressure Control - Closed Loop - This figure shows the closed loop control/drive of proportional valves.**

Electrical

The Pneumatics Module provides pneumatics control and air pressure to enable the use of various pneumatics tools such as cutters, scissors, and forceps, and functions such as AGF and VFC. The Pneumatics Module electronics hardware allows control and actuation of on/off and proportional valves, and provides pressure sensor reading for control of these valves, all under software control. The electronics hardware is composed of the following PCBA's.

- The Pneumatics Controller PCBA can be partitioned into kernel and application parts. The kernel provides and supports the Ethernet connection which allows the Pneumatics Module to communicate with the host via the supervisor. The application part of the controller provides valve drivers, DC/DC converters, pneumatics RFID interface, and other circuitry. The Controller PCBA also interfaces with the Transducer Interface and Air Distribution PCBA's.

- The Pneumatics Transducer Interface PCBA interfaces with all the pneumatics module valves and pressure sensors. This PCBA routes valve driver signals from the Controller PCBA to respective valves, and provides 10 conditioned (amplified and filtered) pressure sensor signals to the kernel ADCs, via the Controller PCBA.

- The Air Distribution PCBA resides outside of the Pneumatics Module. It provides access to the main air pressure source. This PCBA routes a single valve driver signal from the Controller PCBA to an on/off valve, and provides two conditioned (amplified and filtered) pressure sensor signals to the kernel ADCs, via the Controller PCBA. ••••

U/S Diathermy Module

The US module includes two PCBs, a large controller with an integrated NGVS PowerPC kernel designed to provide simultaneous ultrasound and diathermy power to respective handpieces, and a smaller PCB used to illuminate colored rings around connectors at the front of the module. The colors reflect the state of a particular connector and/or the attached device.

Other components which are part of this module include two US handpiece interface cables, one diathermy probe interface cable, an interface cable to the Ring Illumination PCB, a sheet metal enclosure, and a plastic face plate.

The block diagram shows the different functions of the US module. They include power conversion, kernel, ultrasound driver, diathermy driver, and ring illumination control.

Power Conversion

The US module is designed to operate on a single 24 VDC supply at a maximum current of 6 A. Inside the module, the 24 VDC is filtered and converted to nine other voltages required by the module's electronic components.

The block diagram shows the structure of the power conversion scheme for the US module with the inputs and outputs of the various regulators.

Input Filters

Two common mode and one differential mode filters are implemented to limit noise and emissions from the +24 V DC input power line to the module. The first common mode filter is a high frequency

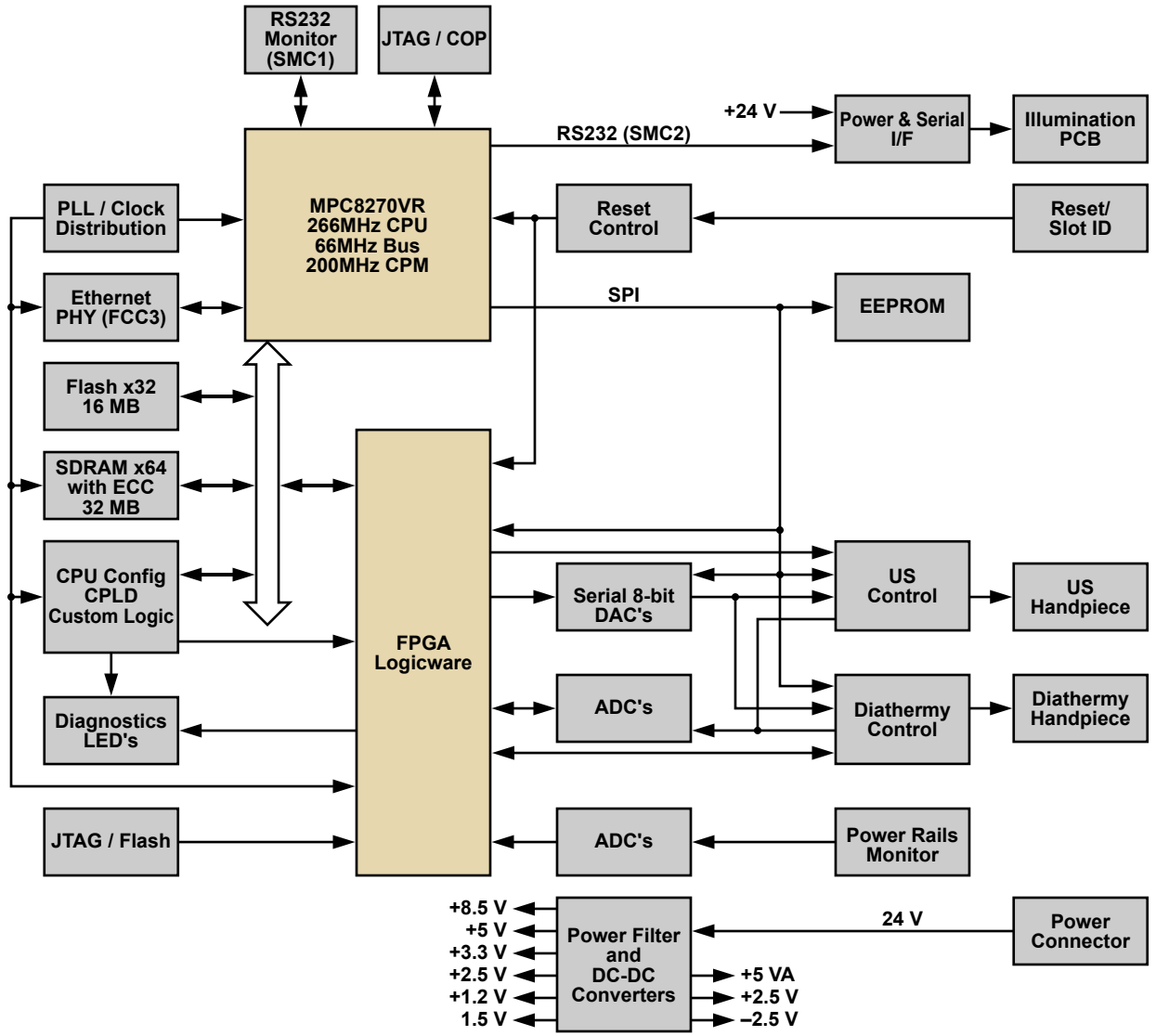


Figure 2-22 U/S Diathermy Module

two stage filter (L36, L37, C608, & C609) designed to attenuate harmonics of 66 MHz CPU clock and prevent them from escaping the module or radiate off the power cable.

The second common mode and the differential mode filters are built around L2 and L1; they are intended to control the internal power converter harmonics up to 30 MHz, and to protect the module from external power disturbances.

This extensive filtering serves to reduce EMI, and to present a constant impedance to the system power source regardless of the switching or loading fluctuation of the internal DC-DC converters.

Input Power Protection

To meet safety and immunity requirements the module uses 7 A resettable fuse F1 for over-current protection, and 26 V transient voltage suppressor CR1 to limit high voltage transients.

Power Conversion

The DC voltages are designed to meet the power requirements of the different components used inside the module. The DC converter topologies are chosen based on efficiency and current requirements.

The +5 V and 3.3 V are generated using dual phase synchronous converter U5. They are designed for a continuous load of 4 A each.

The +8.5 V is generated at U4, designed for a maximum current of 3 A. It is used to power the FET drivers.

The analog supply +5 VA is derived from +5 V. It is used to power precision analog components such as ADCs, DACs, and operational amplifiers. Analog supplies +2.5 V and –2.5 V power the RMS to DC converters and the difference amplifiers. The +2.5 V is generated from +5 V with low dropout regulator U3, and the -2.5 V is also generated from +5 V using sepic converter U123; both outputs are designed for a maximum current of 0.3 A.

Digital power sources +1.2 V for the FPGA and +1.5 V for the CPU are generated using two synchronous converters U8 and U6. The converters have integrated FETs and are capable of supplying 4 A to the load. On the module the requirement is about half that value. +2.5 V required by the FPGA is designed for a 1 A load using U7.

The digital voltages are continuously monitored using the POWER_GOOD signals from U6, U7, and U8. These signals are wired-ored together and connected to pin F13 of the FPGA at U23. Logic inside the FPGA uses this signal to reset the module in case these voltages exceed their preprogrammed 10% tolerance.

Power Supply Monitoring

Each of DC voltages has a visual status indicator and is monitored through a dedicated channel of kernel ADCs U63 & U65. ADC U65 is also used to monitor board temperature VTEMP, and reference voltages 2.048 V and 4.096 V.

Kernel

The kernel refers to the microcomputer on the PCB. It consists of a 32-bit MPC8270 power-pc processor running at 266 MHz, DRAM and flash memories, ethernet phy, an FPGA, a CPLD, four 8-channel 16-bit ADCs, and two 8-channel 16-bit DACs. Other key features are listed in Table 2-6.

Feature	Description
Processor	MPC8270VR, 266 MHz Core, 200 MHz CPM, 66 MHz bus.
SDRAM	Up to 64 Mbyte @66 MHz clock rate. Bus width is x64, with ECC option.
FLASH	Up to 64 Mbyte Spansion MirrorBit FLASH Bus width x32.
PCI	PCI not used.
Ethernet Port	10/100 Base T Ethernet ports, Intel LXT971. MII interface, MDIO and MDIC generated by CPLD.
Ethernet LEDs	RJ45 connectors / with LEDs.
Monitor Port	2x5 header for TXD, RXD, & GND.
JTAG/COP	2x8 header, wired per MPC8270 documentation.
JTAG/CPLD	2x5 header for CPLD programming.
LEDs	Power (+5V, +3.3V, +1.5V, +24V, +1.2V, +2.5V). Four Status (customer: SYSERR, SYSRDY, PWRGD, HBEAT). Two user LEDs controlled by CPLD.
Reset Switch	Pushbutton mechanical switch.
Power Supply	+24 V input power.
FPGA	Xilinx XC3S1000.
ADC	LTC1867.
DAC	LTC2600.

Table 2-6 Kernel Features Summary

Communication
The US module kernel is assigned IP address 192.168.1.4, and uses the UDP protocol to communicate via Ethernet to the NGVS supervisor.

SPI Bus
The Serial Peripheral Interface (SPI) controller is integrated inside the 8270 PowerPC. It is a common resource used to communicate to serial devices used in the module and the US handpieces.

The SPI protocol is chosen for its speed and ability to communicate variable-length synchronous data packets. It uses three unidirectional lines (MISO, MOSI and SPICLK) that makes it relatively easy to have isolated communication when required.

There are three types of devices in the US Module that use SPI: serial EEPROMs built into the US handpieces and a similar EEPROM at U13 on the US Controller PCB, serial 8-bit Digital to Analog converters U29 & U32, and Numerically Controlled Oscillator (NCO) U27.

In addition to MISO, MOSI, and SPICLK, each SPI device requires a separate line to select it and set it in communication mode. The FPGA is used to generate these SELECT signals using a 4-to-16 bit decoder based on the least significant four bits of register DIO0. A list of the SPI devices and their addresses is shown in Table 2-7.

Address 0	Numerically Controlled Oscillator (U27).
Address 1	Current DAC (U29).
Address 2	Current DAC (U32).
Address 3	US handpiece EEPROM port 1.
Address 4	US handpiece EEPROM port 2.
Address 5	Serial EEPROM on the PCB (U13).
Address 6-14	Not used.
Address 15	None. Used to deselect a channel.

Table 2-7 SPI Devices Address Map

Ultrasound Driver
The ultrasound driver refers to the US programmable DC-DC converter, the NCO, US push-pull amplifier, and the associated FPGA logic and feedback circuits. It is operated in closed loop control to maintain safe and efficient operating conditions for the patient and the handpiece (see Figure 2-23).

Numerically Controlled Oscillator (NCO)
NCO U27 is a 32-bit programmable frequency generator. It is programmed using the SPI interface to generate a desired ultrasound operating frequency in the range of 35 KHz to 45 KHz with 0.009 Hz resolution. It uses 16.67 MHz reference oscillator Y2.

The NCO output is routed to the FPGA and manipulated to generate two complementary square waves to drive the MOSFETS of the ultrasound push-pull amplifier. In normal ultrasound operation mode, the NCO output frequency is adjusted every 1 mS to maintain the handpiece impedance close to its tuned value, and to keep the internal piezos off their resonance points.

U/S Programmable DC-DC Power Supply
This circuit uses synchronous controller U28. It is designed to operate at a constant switching frequency of 150 KHz and deliver a programmable DC output in the range of 0 to 23 V. U28 drives two external n-channel MOSFETs Q8 and Q10 with pulse width modulated (PWM) signals. Top MOSFET Q8 is turned on at the start of a clock cycle, then turned off when inductor L12 current exceeds 10 A, the threshold peak current set at ITH. While the top MOSFET is turned off, bottom MOSFET Q10 is turned on until either the inductor current reverses or the next cycle begins.

U28 pin 8 is left open to allow the DC output to be adjusted by U29, a 0 to 50µA SPI based 8-bit current DAC placed in the feedback loop. When the DAC current is varied, it causes the voltage sense pin Vosense of U28 to change and the output to change. Vout can be linearly adjusted from 0 to about 23 V when the DAC output is reduced from 50µA to 0µA.

Ultrasound Push-Pull Amplifier
The ultrasound power amplifier generates a sine wave of the same frequency as the NCO, with adjustable output power of 0 to 35 W into 2500 Ω. The amplifier consists of power transformer T4 with two primaries and one secondary winding configured in a 20:1 turn ratio. Two leads, one from each primary, are tied together to form the transformer center tap, and the other lead of one primary is connected to the drain of power MOSFET Q23 while the other to the drain of power MOSFET Q24.

The center tap of T4 is connected to the output of the DC-DC converter VPHACO. It is used to set the amplitude of the output sine wave. Phaco_CLK1 and Phaco_CLK2 are two complementary clock signals derived from the NCO clock inside the FPGA used to drive the gates of Q23 and Q24, respectively. The resulting waveform at the secondary of T4 is heavily filtered by the low pass

filter formed by L17, C319, and C320 to turn it into a clean sine wave.

The amplifier can be operated in continuous or pulse modes. In pulse mode it is necessary to cut off power to the output at the end of each pulse. This is accomplished by turning Q11 off, and in either mode, when it is necessary to reduce the output power, the DC-DC converter is disabled by turning Q9 on, and its output capacitors are discharged by turning Q13 on.

Ultrasound Voltage and Current Feedback

The ultrasound function is controlled by the module application software which uses concurrent power and frequency PID (Proportional, Integral, and Derivative) loops to control and drive the ultrasound handpiece safely and efficiently.

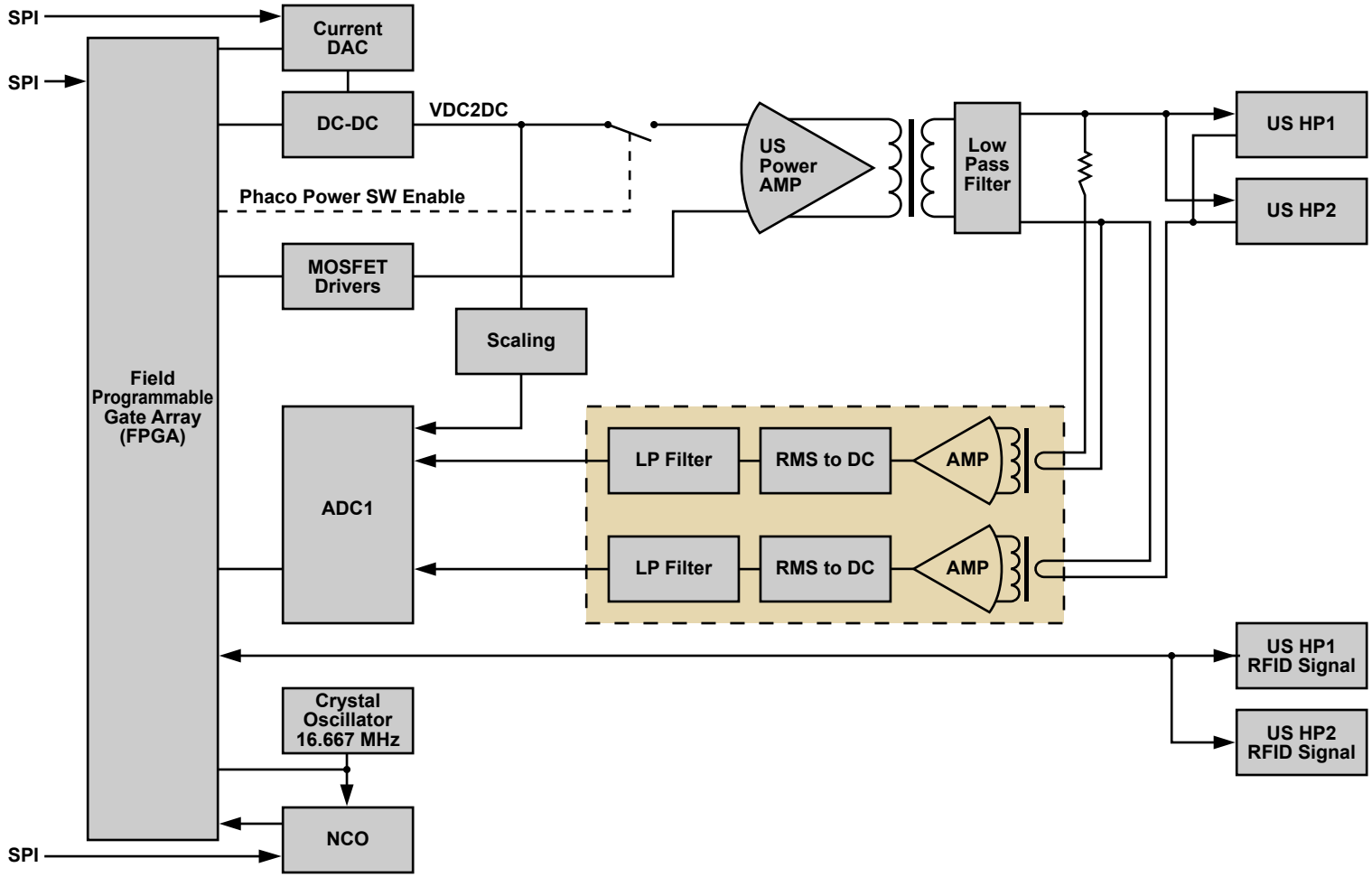


Figure 2-23 U/S Driver

The PID controls depend on parameters such as tune power, tune frequency, and power versus tip displacement table read directly from the handpiece EEPROM, and handpiece voltage and current measured in real time.

The handpiece voltage is sampled at the secondary of transformer T4, using R321 and 50:1 ratio transformer T5. The secondary of T5 is converted to voltage, then amplified five times using difference amplifier U50A before it is converted to a DC voltage using RMS-DC converter U48.

RMS-DC converter U48 operates from ±2.5 VDC. It has a maximum output of 0.707 V which correspond to an input of 1 V peak. The 1 V peak limitation defines the gain of U50A, and the 0.707 V maximum output defines the gain of the ADC driver amplifier to insure that its output falls within the allowed ADC range of 0 to 4 V.

The RMS-DC converter output is filtered first by a two-pole Sallen-Key type filter, then by a single-pole RC filter. The output of the second filter is amplified 5.1 times by non-inverting amplifier U49B. The gain of U49B is calculated using the maximum ADC input 4.096 V divided by the maximum output of RMS-DC converter 0.707 V, and the result is reduced by 0.5 V to account for amplifier offset and bias errors.

In a similar fashion, the handpiece current feedback is sampled with 50:1 ratio current transformer T6. The voltage output of T6 is reduced by 50% by difference amplifier U50B to bring it within the range of RMS-DC converter U52. The U52 output is filtered in the same way as voltage using opamp U43.

When ultrasound function is active, the FPGA samples the ADC values of the handpiece voltage and current as well as the DC-DC converter voltage every 80µsec.

Ozil® and Frag Handpiece Support

Ozil® and Frag handpieces are supported by the same US amplifier. No special hardware is required. In _Ozil_® mode software switches the amplifier between two different frequencies, one for longitudinal and the other for transverse operation. And the pulse width and amplitude of each is set to meet a specific power need.

Handpiece Interface Circuit

Each ultrasonic handpiece has a built-in serial EEPROM that contains specific parameters necessary for the system to determine its type and tuning parameter such as: Handpiece ID, calibration parameters necessary for proper standard ultrasound stroke at full power, calibration parameters necessary for proper Ozil ultrasound stroke at full power, and the tune start and end frequencies.

When phaco is inactive, the SPI controller continuously hunts for a handpiece to determine when a new handpiece is inserted or removed from the US module.

Functionally the US driver has a single output, but a second port wired in parallel with the first is added to give the user a backup physical connector. The low voltage signal wires of the handpiece cable are isolated from the high voltage to prevent possible crosstalk.

Diathermy Driver

The diathermy driver is a proportional bipolar high frequency amplifier. It is designed to output a 1.5 MHz sine wave to drive electrosurgical probes for the purpose of coagulating vessels and other soft tissues. The amplitude of the sine wave is adjustable via a programmable DC-DC converter. A power control PID loop is implemented in software to limit and control the power delivered to the probe (see Figure 2-24).

The 1.5 MHz base frequency is generated from a fixed source inside the FPGA, and is used to generate COAG_CLK1 and COAG_CLK2 complementary clock signals to the diathermy amplifier MOSFETs, and set the frequency of the sine wave.

Programmable DC-DC Power Supply

This circuit is a replica of the one used for ultrasound. It is based on synchronous controller U31, designed to operate at a constant switching frequency of 150 KHz and deliver a programmable DC output in the range of 0 to 23 V. Pin 8 of U31 is left open to allow the DC output to be adjusted by U32, a 0 to 50µA SPI based 8-bit current DAC placed in the feedback loop. When the DAC current is varied, it causes the voltage sense pin Vosense of U31 to change, and the output to change.

Diathermy Push-Pull Amplifier

The diathermy power amplifier is designed to drive up to 15 W, 1.5 MHz sine wave into a 75 Ω load. The amplifier consists of the programmable DC-DC converter, power switch Q17, high frequency power transformer T8, and two power MOSFETs Q25 & Q26.

The output of DC-DC converter VDIA is tied to the center tap of T8. VDIA level sets the amplitude of the output sine wave. COAG_CLK1 and COAG_CLK2 are two complementary clock signals derived from the 1.5 MHz clock inside the FPGA, used to drive the gates of Q25 and Q26. The resulting waveform at the secondary of T8 is filtered by L21 and C330 to make it a clean sine wave.

Diathermy Voltage and Current Feedback

The diathermy output voltage is sampled on the secondary of power transformer T8 using a 50:1 of transformer T7. The secondary of T7 is converted to voltage then amplified 1.18 times using high speed difference amplifier U55A. The output of U55A is converted to a DC voltage using RMS-DC converter U53.

The output of the RMS-DC converter is filtered first by a two-pole Sallen-Key type filter, then by a single-pole RC filter. The output of the second filter is amplified 5.1 times by non-inverting amplifier U30B. The gain U30B is calculated using the maximum ADC input 4.096 V divided by the maximum output of RMS to DC converter 0.707 V, and the result is reduced by 0.5 V to account for amplifier offset and bias errors.

Similarly, the diathermy current is sampled at the secondary of power transformer T8 with another 50:1 ratio current transformer T9. The output of T9 is converted to voltage, then attenuated 80% by difference amplifier U55B to bring it within the acceptable input range of RMS-DC converter U57. The RMS-DC output is filtered and amplified in the same way as the voltage.

When the diathermy function is active, the FPGA samples the ADC values of the diathermy probe voltage and current as well as the DC-DC converter voltage every 80µsec.

Ring Illumination PCB

The Ring Illumination PCB uses PIC18F4410 microcontroller from microchip to control the lighting of three color LEDs forming light rings around five connectors on the front connector

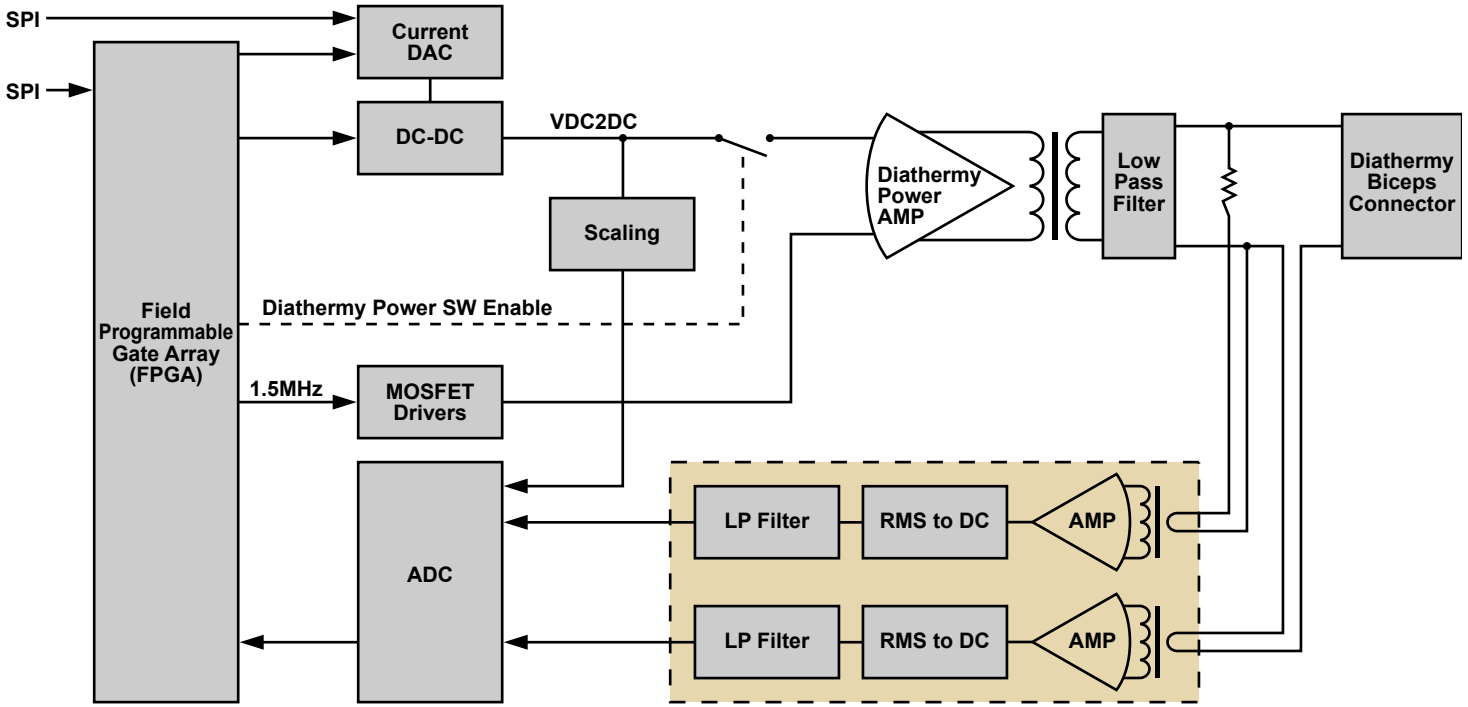


Figure 2-24 Diathermy Driver

panel (see Figure 2-25). Each ring is made of 12 discrete tri-color LEDs. The anodes of all the LEDs are tied together to +5 V, and the cathodes of each color from around each ring are tied to a single n-channel MOSFET. Each MOSFET is driven by a programmable duty cycle output pin from the microcontroller. A total of 12 outputs are used as the two rings for the diathermy are driven in parallel. The microcontroller runs from a 10 MHz external oscillator and has a JTAG interface for testing and programming.

Power and Protection

Isolated power is provided from 3 W, 24 V to 5 V DC-DC converter U104 on the US Controller. Isolation is required because of the PCB proximity to the handpiece connectors.

Fuse F1 is used to prevent possible overloading of the DC-DC converter, and to protect against overcurrent conditions that may occur on the board. CR61 is used to protect against voltage transients over 6 V.

LED Color Interpretation

The different LED colors are chosen to indicate the status of an entry port or the device attached to it when selected for a particular surgical procedure. Ring colors identify the connector status. Blue indicates that the port is ready and is expecting a device to be connected. Green indicates that the device is connected and working properly. Amber indicates that the device is connected, but it may be the wrong device, or it may not be functioning properly.

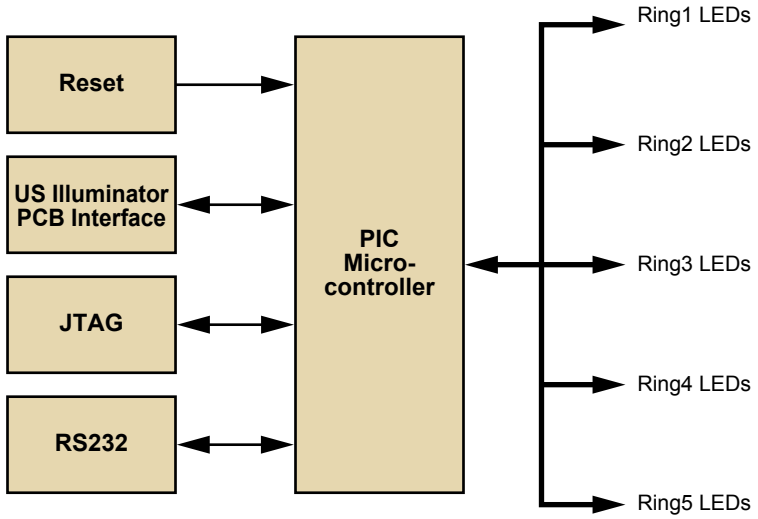


Figure 2-25 Ring Illumination PCB

The brightness of different colors is independently controlled for each ring; it can be adjusted in 224 discrete steps by programming the duty cycle of that color MOSFET driver.

Communication

The PIC18F4410 communicates to the PowerPC SMC2 serial channel at 38400 baud over a standard RS232 interface. Transmit (SMC2_TXD) and receive (SMC2_RXD) lines are optically isolated by U107 and U108 on the US Controller PCB to meet the creepage and clearance requirements defined for the system, and to ensure the Ring Illumination PCB is remains electrically floating.

The use of standard RS232 levels allows flexibility in the choice of test equipment and maximizes communication reliability.

Reset

The PIC processor on the Ring Illumination PCB can be reset in two ways: pushbutton switch S1 on the Ring Illumination PCB which is accessible only during testing, and isolated signal RESET_ILLUM. RESET_ILLUM is generated either from the module main reset line RESET_SYS# or the module software by setting bit 0 of DIO register C0010C00 to one.

All physical connections, including power between the US Controller PCB and the Ring Illumination PCB, are made with a one-to-one cable between J20 on the US Controller PCB and J2 on the Ring Illumination PCB.

• • • •

Footswitch

Input to the *Constellation*® system is accepted from a footswitch. The physical structure and function of the *Constellation*® footswitch is broken into two major subassemblies: the main footswitch assembly and the toe/heel switch assembly. The main footswitch assembly houses the treadle and detent mechanisms. The toe/heel switch assembly consists of the housing, environmentally sealed switches, and switch activation mechanism.

Main Footswitch Assembly

The main footswitch assembly consists of a treadle mechanism and six side switches. There are four switch actions on the front of the footswitch (two switches, each with horizontal and vertical action) and two at the heel (vertical action).

The treadle mechanism consists of a treadle, treadle shaft, and gear drive mechanism. The treadle rotation is transmitted to a DC motor to provide three tactile detents by means of a gear drive mechanism. The treadle angle of rotational motion is picked up by the encoder that closes the signal/treadle position loop. Once the treadle force is released, the extension spring returns the treadle to its home position.

The heel switch assembly consists of the switch housing, switch cover plate-striker, electro-mechanical pushbutton switch, rear fulcrum device, and front cover support device. The heel switch assembly (left and right) is mounted on the rear side of the main footswitch housing.

Operational Description

Most of the surgical functions such as irrigation, aspiration, vitrectomy, phacoemulsification, *AquaLase*®, diathermy, and reflux are controlled through the footswitch. Major footswitch subassemblies are described in this section.

Treadle Mechanism

The user depresses the treadle to generate a desired signal. The treadle rotates about its shaft under applied pressure. There are four treadle tactile detents, designated 0, 1, 2, and 3. Position 0 is the home, fully upright, treadle position. Positions 2, 3, and 4 are programmed according to system specifications. The return spring tension is adjusted by turning a knob on the front of the footswitch.

Toe and Heel Switches

These pushbutton-type switches are used to enable and disable system functions. The toe switches (one on each side, with two activations each) are activated by pressing the switch cover sideways (horizontally) or down (vertically). The surgical functions the toe switches control are user-remappable, and may include the following: enable/disable cutting in vitrectomy mode, enable/disable U/S in a fragmentation mode, infusion or F/AX mode, diathermy mode, etc.

Each heel switch is activated by depressing the switch cover vertically. The cover pivots about a rear fulcrum and about a front support device. It may rotate about these pivot points or translate vertically down and activate a single pushbutton switch. This complex cover plate motion gives the user the feeling of a “floating” heel switch. The surgical functions the heel switch controls are user-remappable and may include reflux.

Encoder

The incremental type, panel mount, optical encoder used in the *Constellation*® footswitch, is coupled with the treadle rotation shaft by means of a gear train with a gear ratio of 5:1. It is a non-contacting rotary to digital converter with 500 cycles per revolution. The encoder is used as a position feedback device. It converts real-time shaft angle, speed, and direction into TTL-compatible outputs (two digital waveforms 90˚ out of phase). This encoder utilizes an unbreakable mylar disk, metal shaft and bushing, LED light source, and monolithic electronics. It operates from a single +5 VDC supply.

Vertical Treadle Position

The footswitch treadle is connected to an encoder which outputs quadrature information. This quadrature information is converted to a relative position by the FPGA. The current position is stored in this register. The register contents are cleared by the FPGA upon power on reset, or due to a true (high level) Treadle Up (vertical) signal from the footswitch.

Horizontal Treadle Position

The footswitch treadle is connected to an encoder which outputs quadrature information. This quadrature information is converted to a relative position by the FPGA. The current position is stored in this register. The register contents are cleared by the FPGA upon power on reset, or due to a true (high level) Horizontal Home signal from the footswitch.

Switch Register 1

The footswitch switch register is used to sense the condition of the footswitch switches.

Vertical Detent PWM
The footswitch vertical detent PWM is used to give force feedback to the surgeon. A zero value gives no force feedback and a 0xFFFF gives the maximum amount of force feedback.

Controlling Supervisor Board
The footswitch controlling supervisor board is located in the *Constellation*® console.

Treadle Spring Failure Input Mechanism
The treadle spring failure input mechanism consists of a normally-closed 2-pin switch, stainless steel gold plated push plate, and a push plate mounting lever which is attached to a treadle rotation shaft. The treadle tension adjustment spring preloads the push plate against the two pins. In case of spring failure, the contact between the two pins and a push plate breaks, upon which an electrical signal is sent to the console to warn about the failure.

Footswitch PCB
The Footswitch PCB passes the switch and treadle encoder signals to the Supervisor PCB. The software running on the supervisor receives and processes the switch signals and reads the encoder signals for the treadle position.

Button Switches
The PCB reads the six switch signals from two cables to six momentary switches and outputs them at TTL level outputs to the *Constellation*® supervisor module to indicate the switch status.

Treadle Home Position Sensor
The PCB reads the spring detection sensor signal for Treadle home position, and outputs it at TTL level to the *Constellation*® supervisor module.

Treadle Position
The PCB outputs two-channel quadrature signals from an optical encoder at TTL level to the *Constellation*® supervisor module to indicate the relative position of the footswitch, and to provide linear proportional control. The treadle position is reset by the treadle home sensor.

Detent Motor
The footswitch uses a DC motor to provide force detents and vibration to delineate positions of the footswitch treadle. The number of, location of, and values for the detents and vibration are programmed by the Supervisor PCB based upon the treadle position, which was output by two output signals from the encoder.

Footswitch PCB Revision Output
The voltage divider (resistors on the Footswitch PCB and on the Supervisor PCB) provide a voltage signal to the Supervisor module to distinguish different models of footswitches.

PCB Tilt Switch
The Footswitch PCB has a “tilt tip-over” device installed. The tilt switch operates when tilted from the horizontal position. It is a normally open, non-mercury, contacts switch. The switch movement required to cause control change, off to on, is called the differential angle. When the footswitch is in an operational position, the tilt switch is in its open position; the circuit goes through the tilt switch and a MOSFET device and provides the +5 VDC return signal. When the footswitch tilts more than 60 degrees (±10 degrees) or totally turns over, the tilt switch closes, shutting off the +5 V power supply for the PCB, disabling all of the switches.

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Remote Control

The *Constellation*® remote control is the same as the remote control for the *Infiniti*® system with only minor modifications to cosmetics and top assembly numbers. The remote control's primary components consist of an elastomeric keypad, a PCB that houses the functional electronics, and enclosures that embody the assembly. The remote control is powered by three AAA batteries.

Keypad
The keypad is the user input mechanism for the remote control. The keypad has an elastomeric sheet with formed buttons which protrude through holes in the bezel to form individual keys. Each of these keys has printing on them to indicate which parameter it controls. This elastomeric sheet is sandwiched between the bezel and the PCB. Metallic snap domes are mounted beneath each key to make electrical contact with traces on the PCB when depressed.

Remote PCB
The Remote PCB houses components that serve an assortment of purposes. These components include, but are not limited to, contact traces to create signals, a microprocessor with onboard Flash RAM to process the signals, and IR transmitters to emit the signals. Additionally, the PCB houses a photo-detector to sense low ambient light conditions, and blue LEDs to illuminate the elastomeric keys.

Enclosures
There are two enclosures in the remote control assembly: the front bezel, and the base. The bezel is molded from an IR transparent grade of polycarbonate. This material is molded inside a thin sheet of polycarbonate. For aesthetic reasons, this film has artwork printed on the back side prior to molding. The bezel face has holes that match the shape of each of the keys so that the keys protrude through them when assembled. Additionally, there is a hole in the molded plastic that does not extend through the artwork that allows the transmission of visible light for activation of the previously-mentioned photo detector. The back side of the bezel has a locating post and screw bosses to allow for the mounting of the PCB. There is also a pair of threaded inserts heat staked into the post for the fastening to the base.

The base covers the back side of the remote control. Its exterior is mostly covered with an over-molded elastomeric material that increases friction with the users hand as well as with the surface on which it is resting. An uncovered portion is used to mount the product label. The interior surface has features to house battery contacts and the batteries themselves. Captive fasteners are also mounted to the base for fastening it to the bezel to hold the assembly together.

Operational Description
When the user depresses a key on the elastomeric keypad a signal is generated. This signal is then translated into infrared (IR) digital signals, based upon the USB standard 101-keyboard key codes, and transmitted out the front side of the remote assembly. The IR receivers and supporting electronics in the *Constellation*® system's front panel display receive and interpret these keyboard signal codes and provide the signal to adjust the desired parameters.

Keypad Activation
When a user applies force on a given key, the elastomeric material deflects inward and applies pressure on the metallic snap dome mounted on the PCB. When a sufficient force is applied, the snap dome flips over center and contacts a series of parallel traces on the PCB. This contact closes a circuit on the PCB that sends a signal to the microprocessor. Each key has a dedicated circuit so that the microprocessor can detect which key is depressed.

Signal Processing
When a signal arrives from one of the keypad circuits, the microprocessor receives the signal and, using the software algorithm stored in the flash RAM, sends out a unique coded signal to the IR transmitters mounted on the front edge of the PCB.

IR Transmission
The IR transmitting LED's send out infrared digital code which is unique for each key depression. This signal passes through the IR transparent material of the bezel and is received and processed by the tabletop.

Illumination
The remote control keys are illuminated during low light conditions. Blue LED's on the PCB are located beneath each key pad, and the elastomeric material of the keypad is semi-translucent. As a result, the light from the energized LED's causes the keys to glow.

Keypad illumination can be triggered either manually or automatically. Manual illumination occurs when the user depresses one of the illumination keys located on the side of the remote control enclosure. In this case the depressed key activates a momentary switch mounted on the PCB. This switch completes a circuit that sends a signal to the microprocessor which in turn completes a circuit to energizes LED's located beneath each key. Automatic activation of the illumination is triggered by the photo-detector mounted on top of the PCB. Light is allowed to penetrate through a window in the bezel directly above the photo-detector. When both the detected light level falls beneath the given threshold and any key is depressed, the microprocessor completes a circuit and the LED's are energized.

Remote Control Channel Selection

The remote control can be configured to operate on one-of-four channels. This feature allows four remote controls to independently control four *Constellation*® systems operating in the same room or area. Remote controls are factory preset to channel A. For proper remote operation, the *Constellation*® system must be set to the same channel as the remote. See operator's manual for instructions.

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Constellation® / *PurePoint*® Laser

The *Constellation*® System has two methods of laser interface, and in both of these schemes control of the laser settings (power, exposure, etc.) is made through the *Constellation*® System's user interface by means of its touch screen.

- Tethered Console - In this configuration a complete *PurePoint*® Laser console is positioned close to the *Constellation*® System, and operates in a "tethered" capacity by means of an ethernet cable connection.
- Internal Laser Core Module - The *Constellation*® System uses a standard *PurePoint*® Laser "core module" as the main electro-optical component, mounted and contained within the base assembly of the *Constellation*® System. The core module consists of an optics block assembly and two principal circuit boards. More detail can be found in the *PurePoint*® Laser Service Manual.

Core Module Interface - To interface the standard *PurePoint*® Laser core module into the *Constellation*® System chassis, a number of mounting panels and air-ducts are added within the lower base assembly. Within the mounting duct-work are two circuit boards:

- Extender PCB - A portion of this PCB is spring-mounted and has flexible electrical traces that allows a section of the board to "float." This arrangement provides some flexibility to allow the Extender PCB's main 72-pin connector to mate properly with the corresponding connector on the core module. It is through this 72-pin connector interface that all control signals are directed to tether the core module to the *Constellation*® System.
- Breakout PCB - The Breakout PCB contains the connectors, drivers, and signal protection needed to attach the various external devices such as the footswitch and Dr. Filter(s). This PCB supplants the normal Rear Panel PCB used on a standalone *PurePoint*® Laser console, when a core module is integrated into a *Constellation*® System.

The Breakout PCB contains LED's to provide illumination of the connector region on the rear panel. All external connections are protected by surge-supression components and filtered with RF beads. The external interfaces include:

- Footswitch: The Breakout PCB provides +12 V to the footswitch through a common-mode choke. The return signals from the four individual switches within the footswitch are pulled up to +12 V when the associated switch is closed, and these signals are level-shifted to 5 V logic levels and transmitted to the Controller PCB. The 12 V signal from the normally-open main switch is used to power the shutter driver (located on the Bottom Sensor PCB), such that the shutter cannot open unless the footswitch is connected and depressed.
- Doctor Filter: Two doctor filter connections are provided. Each connection is powered with 5 V and provides both normally open and normally closed connections that are transmitted to the Controller PCB from the Power Driver PCB.
- Interlock: This is typically used for a safety door-interlock, if desired by the user. In order for the laser to operate, external connections between J3 pins 1 to 6 must be in place. If these external connections is broken, the processor stops all laser emission. Typically, a jumper plug is inserted to make the connections, or the user may elect to wire to a door switch.
- Laser Ready: P2 pins 1 and 9 are connected within the system through a relay when the laser is in Ready or Firing mode. Connection through these two pins can be put in series with an external lamp to provide and external indicator that the laser is firing, or could be firing at any time. The current path through the relay is protected with fuse F4 within the Core Module.

The Constellation Core Module is identical to the *PurePoint*® Core Module with one exception that the internal ethernet communication cable is routed differently. The cable itself is identical between the two, but in the *PurePoint*® module runs from Planet PCB to Rear Panel PCB, and in Constellation module from Planet PCB to Controller PCB.

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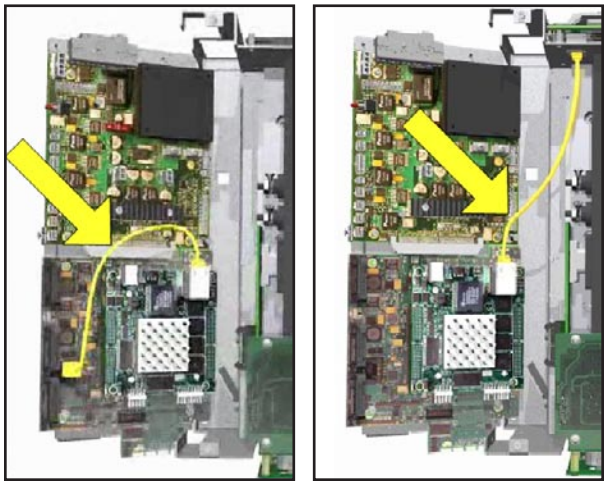

Figure 2-26 Cable Routing - On left is cable from Planet PCB to Controller PCB (*Constellation*® System), and on right is cable from Planet PCB to Rear Panel PCB (*PurePoint*® Laser).

Base Switch

The Base Ethernet Switch, located in the base assembly portion of the system, is the module that allows communications between all the modules in the console and base assemblies (auxiliary illuminator and laser). It serves as an extension to the console's supervisor. The Base Ethernet Switch contains five 10/100 Mbps fast Ethernet ports fully compliant to the IEEE 802.3u standard. The shared memory based switch fabric is a fully non-blocking configuration. All ports are interchangeable and not specifically addressed.

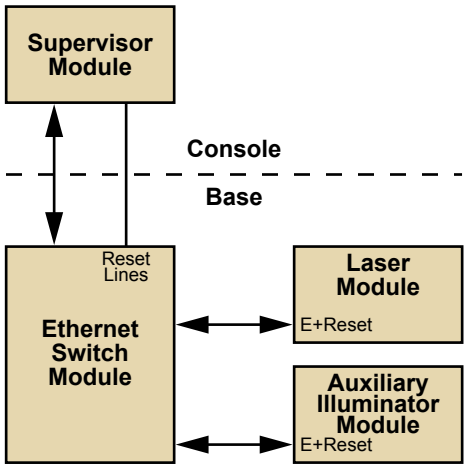

Figure 2-27 Ethernet to Base Switch

Figure 2-27 is an overview of the Ethernet connection from the supervisor through the base switch to the laser and auxiliary illuminator modules. Figure 2-28 shows the base switch.

5-Port Ethernet Switch Controller

The switch controller contains five transceivers, five media access control units, a high-speed non-blocking switch fabric, a dedicated address lookup engine, and an on-chip frame buffer memory. The switch controller is initially reset by passive power on a reset circuit. It is configured as a 5-port integrated switch. The switch controller can also be programmed to perform more advanced features by being configured from the EEPROM.

I²C EEPROM

The EEPROM can store advanced features like broadcast storm protection and rate control. If the EEPROM is programmed, the switch controller will load the information from the EEPROM via an I²C bus on power up.

Power Conditioner

The power conditioner provides conditioned, clean, 24 VDC power to the step-down switching regulators. Over-current protection, over-voltage protection, and noise-filtering circuits are used in this section to protect the board and produce clean 24 VDC for the module.

Step Down Switching Regulator – 24 V to 3.3 V

The step down switching regulator generates 3.3 V at 1.4 A max to power the LED's, the I/O circuitry on the Ethernet switch controller, the EEPROM, and the digital side of the Ethernet magnetics. It also generates analog 3.3 VA to power the physical layer side of the Ethernet magnetics.

Step Down Switching Regulator – 24 V to 1.8 V

The step down switching regulator generates 1.8 V at 1.4 A max to power the core circuitry in the Ethernet switch controller, and analog 1.8 VA to power the physical layer portion of the Ethernet switch controller.

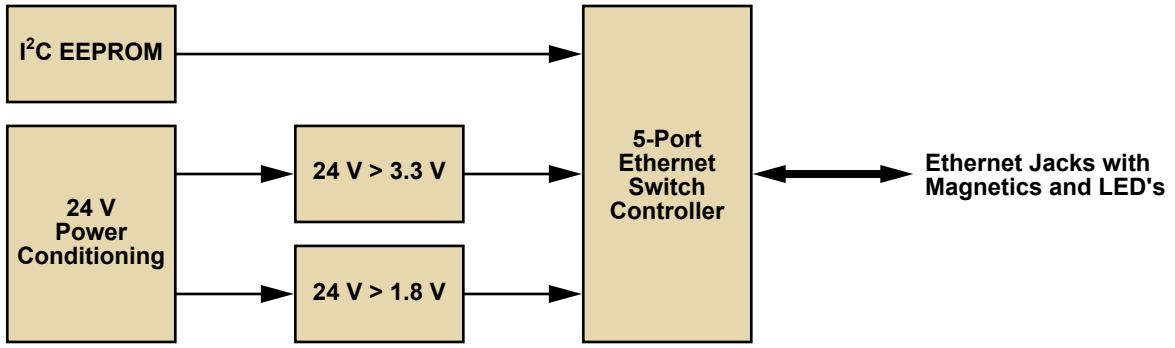

Figure 2-28 Base Ethernet Switch

Table Top Illuminator

The table top illuminator system block diagram is shown in Figure 2-29.

The primary components of the Tabletop Illuminator are the Optics Module, the Ballast Module and the Controller PCBA.

Optics Module
The Optics Module produces, filters, and focuses light into the ACMI output ports of the Tabletop Illuminator module. The Optics Module has a Sigma shaped layout which offers a dual channel output from a single light source.

Ballast Module
The lamp ballast provides the initial ignition pulse and the power necessary to sustain the lamp arc. Once the arc is established the ballast acts as a DC constant current source to the lamp. The lamp terminal voltage is governed by the gas chemistry and arc gap length. The ballast output voltage will therefore vary with lamp type and age.

Controller PCBA
The Controller PCBA acts as an interface board between Optics/Ballast/RFID and the Supervisor PCBA. It receives control signals from the Supervisor PCBA for stepper motor drivers, ballast and fan drivers via the TT blind mate connector board. The controller PCBA sends feedback signals back to the Supervisor PCBA for attenuator home position detection, ballast status, over-temperature conditions, lamp power and temperature readings. It also interfaces control signals for the RFID module for fiber detection, ring illumination and RFID tag R/W functionalities.

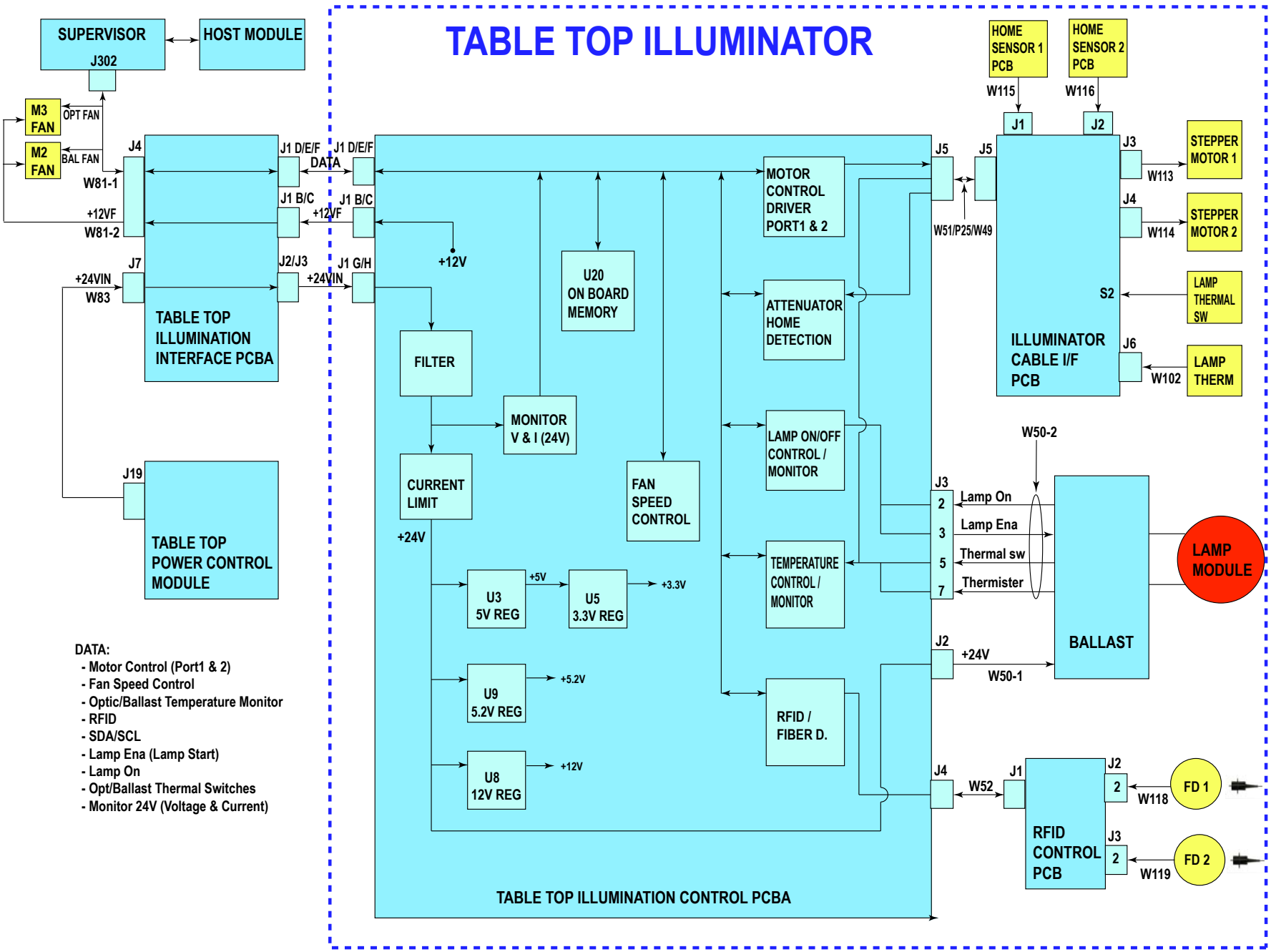

Figure 2-29 Table Top Illuminator Block Diagram

Auxiliary Illuminator

The Auxiliary Illuminator is contained in the base console. The block diagram is shown in Figure 2-30.

The primary components of the auxiliary Illuminator are the Optics Module, the Ballast Module and the Controller PCBA.

Optics Module
The Optics Module produces, filters, and focuses light into the ACMI output ports of the Tabletop Illuminator module. The Optics Module has a Sigma shaped layout which offers a dual channel output from a single light source.

Ballast Module
The lamp ballast provides the initial ignition pulse and the power necessary to sustain the lamp arc. Once the arc is established the ballast acts as a DC constant current source to the lamp. The lamp terminal voltage is governed by the gas chemistry and arc gap length. The ballast output voltage will therefore vary with lamp type and age.

- Ballast Mounting - The base of the ballast will mount to the sheet-metal chassis wall by means captive hardware attached to the ballast.
- Ballast Cooling - The ballast is intended to be cooled by air drawn from a fan located in the rear of the Auxiliary Illuminator Module. Temperature will be monitored by a thermistor in the Ballast module. Feedback from this thermistor will be used by the Kernel located on the Auxiliary Illuminator Controller Board to control the fan speed.

Auxiliary Controller PCBA
The Auxiliary Controller PCBA controls and monitors the Ballast, Optics, and RFID modules. The communication between the PCBA and the main console is through an Ethernet connection.

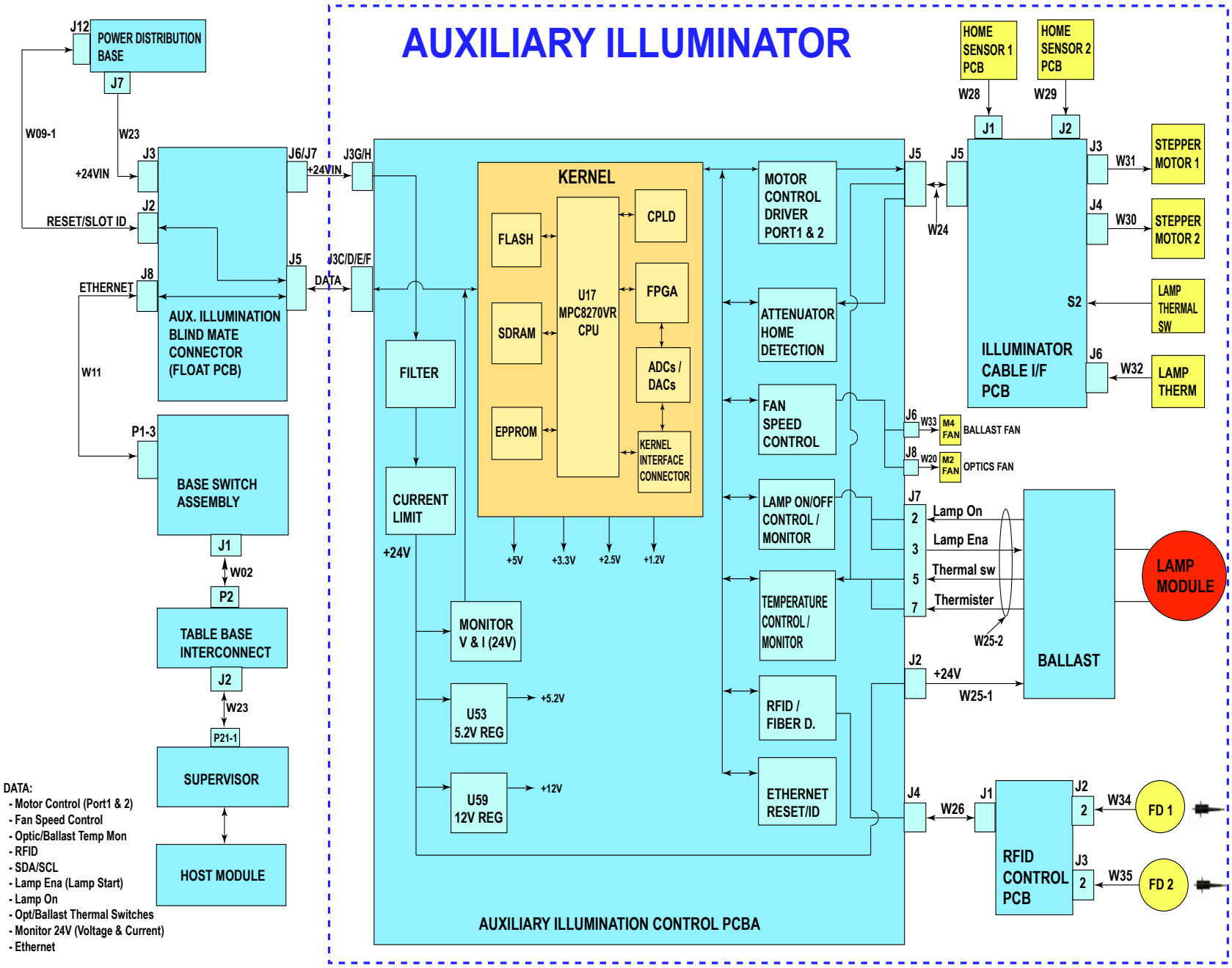

Figure 2-30 Auxiliary Illuminator Block Diagram

SECTION THREE
PARTS LOCATION AND DISASSEMBLY

Introduction

Alcon's *Constellation*® Vision System contains several modules inside the Tabletop and Base assemblies. The instructions in this section of the manual are written to help you remove and replace these modules.

WARNING!
Before performing any internal service you must verify system power is turned OFF and power cord is disconnected from power source.

CAUTION

The *Constellation*® Vision System contains electrostatic discharge (ESD) sensitive devices. Always wear a wrist strap when working with this device.

NOTE: All references to "left" and "right" are directed with the user facing the front of the system.

Module Access and Removal Instructions

1. Remove Top Cover from Tabletop Console (see Figure 3-1)

1.1 Remove stationary bottle hanger, and barcode scanner holder, by turning each until their alignment pins reach slots that allow them to be removed up and out of the sleeves in their holes (alignment pins and slots are not visible until removed, so you must judge their alignment by feel).

1.2 Loosen a captive setscrew in each of two holes that held barcode scanner and bottle hanger.

1.3 Remove top rubber mat to expose four captive setscrews. Loosen all four setscrews.

1.4 Lift cover off tabletop console.

2. Remove Host Module From Tabletop Console

2.1 Remove top cover (step 1).

2.2 Loosen three captive setscrews securing Host Module to tabletop frame (see Figure 3-2). Tilt Host up and towards back of system.

2.3 To remove rear panel from Host, remove two hex screws from left side, and six screws from right side of rear panel (screws are circled in Figure 3-3). Remove rear panel.

Figure 3-1 Remove Top Cover

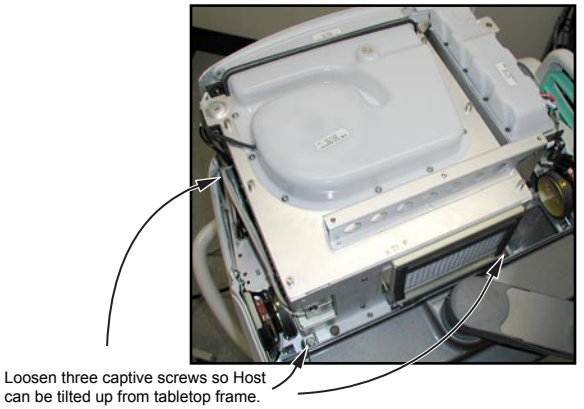

Figure 3-2 Loosen Captive Screws

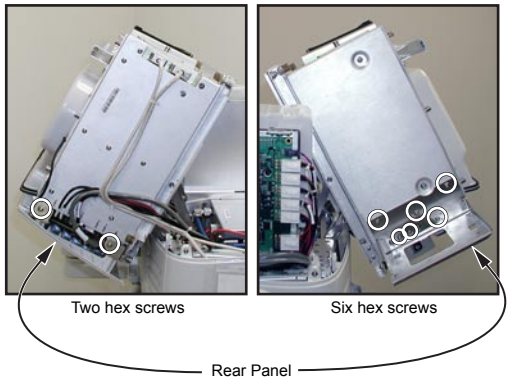

Figure 3-3 Remove Rear Panel From Host

2.4 Disconnect cables from Host assembly and Supervisor (see Figure 3-4 for locations):
- W12 (A2AJ2) on Host
- W13 (A2AJ3) on Host
- W14 (A2BP6) on Host
- W15 (A2BP7) on Host
- W46 (A2BP19) on Host
- W16 (A2PB1) on Host
- W17 (A5A-P22-4) on Supervisor
- W27 (A5A-P22-3) on Supervisor

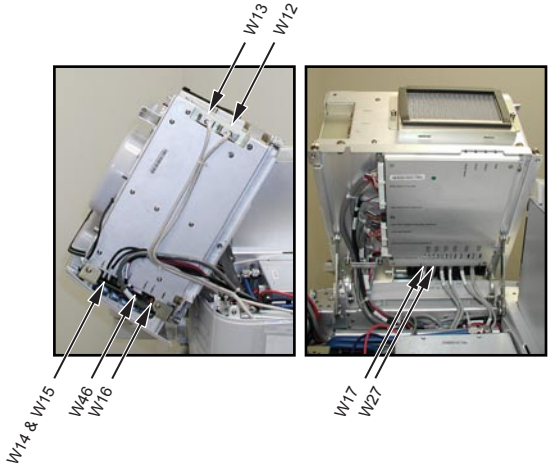

Figure 3-4 Remove Rear Panel From Host

2.5 Tilt Host back into its resting position.
2.6 Cut tie-wraps securing cables to side of Host assembly. When reassembling, secure cables with tie-wraps where shown in Figure 3-4.
2.7 Loosen four captive setscrews securing Host to tabletop frame.
2.8 Lift Host up and out of tabletop console.

3. Remove Fan from Host

The fan on top of the Host also serves as the Host top cover. Removing the fan allows access to the Host's internal components.

3.1 Remove top cover (step 1).
3.2 Disconnect cable W39 (A2BP14) from rear of Host (see Figure 3-5).
3.3 Loosen six captive screws securing fan/cover to top of Host.
3.4 Lift fan/cover up and off Host assembly.

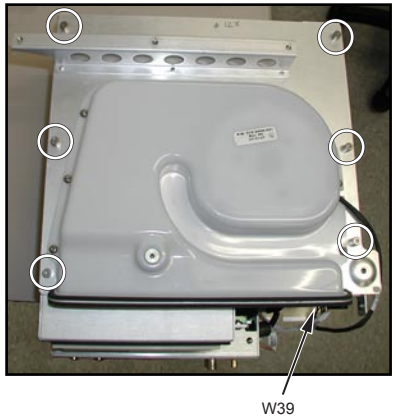

Figure 3-5 Host Fan/Cover

4. Remove DVD From Host

4.1 Remove top cover (step 1) and fan (step 3).
4.2 Unplug Power and Data cables from DVD (see Figure 3-6).
4.3 Loosen two captive setscrews securing DVD player to mounting plate (white circles in Figure 3-6).
4.4 Slide DVD player out from Host.

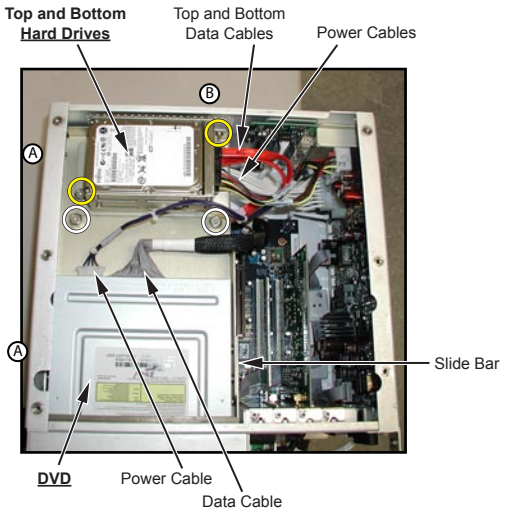

Figure 3-6 DVD and Two Hard Drives

5. Remove Hard Drives From Host

5.1 Remove top cover (step 1) and fan (step 3).
5.2 Unplug Power and Data cables from hard drives (see Figure 3-6). The Data cables must be properly labeled as TOP and BOTTOM to ensure they are replaced into the correct drives.
5.3 Loosen two captive setscrews securing hard drives to mounting plate (yellow circles in Figure 3-6).
5.4 Remove hard drives from Host.

6. Remove DVD/Hard Drive Mounting Plate

6.1 Remove top cover (step 1), fan (step 3), DVD (step 4), and Hard Drives (step 5).

6.2 Loosen two captive setscrews securing screen/filter to front of Host assembly and remove.

6.3 Loosen three captive setscrews securing Host assembly to tabletop frame (see Figure 3-2). Tilt Host up and towards back of system.

6.4 Remove two screws securing mounting plate to side of Host (labeled A in Figure 3-6).

6.5 Remove one screw securing mounting plate to end of Host (where screen/filter was mounted, and labeled B in Figure 3-6).

6.6 Loosen two screws securing slide bar to side of mounting plate, then slide the bar backwards to release mounting plate from Host (location of slide bar shown in Figure 3-6).

6.7 Remove mounting plate from Host.

7. Gain Access to Components Inside Host

7.1 Remove top cover (step 1), fan (step 3), DVD (step 4), hard drives (step 5), and DVD/Hard Drive mounting plate (step 6).

7.2 Components inside Host can now be removed as required (see Figure 3-7).

8. Remove Expansion Module

At this time it is not advisable to remove the expansion panels due to possible changes that are being made to these components.

9. Remove Supervisor

9.1 Remove top cover (step 1).

9.2 Loosen three captive setscrews securing Host Module to tabletop frame (see Figure 3-2). Tilt Host up and towards back of system.

9.3 Unplug six cables across bottom, and six cables along left side of Supervisor.

9.4 Loosen four captive setscrews to release Supervisor, and remove from bottom of Host module.

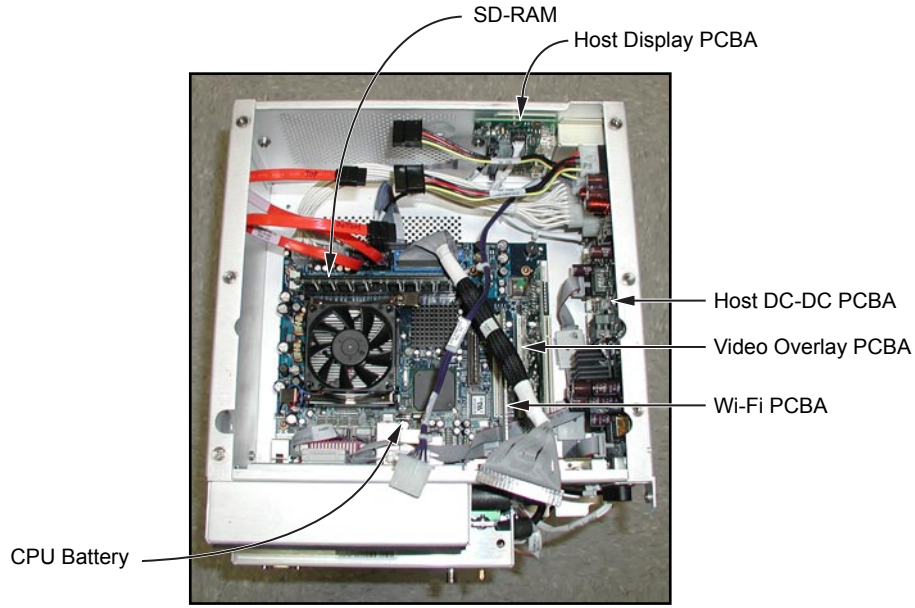

Figure 3-7 Components Inside Host

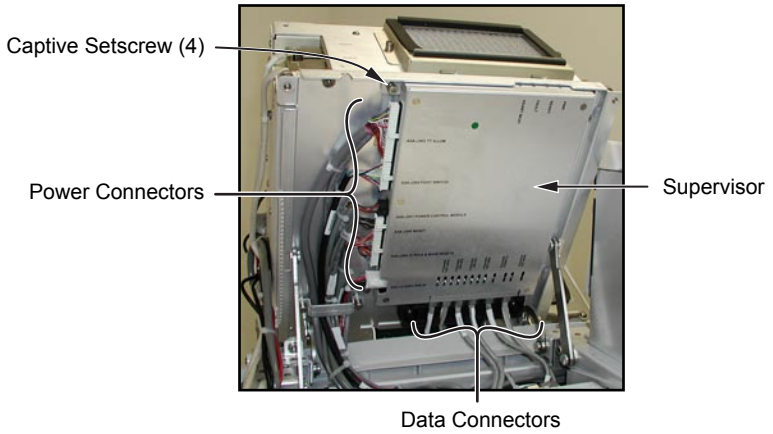

Figure 3-8 Supervisor

10. Remove Power Module

10.1 Remove top cover (step 1).

10.2 Disconnect cables from Power Controller PCB (see Figure 3-9).

10.3 Loosen two captive setscrews at front of power module, and one captive setscrew at rear (insert long hex wrench between power module and rear panel).

10.4 Grasp power module with both hands and lift it up and out of multi-pin connector securing it to Host.

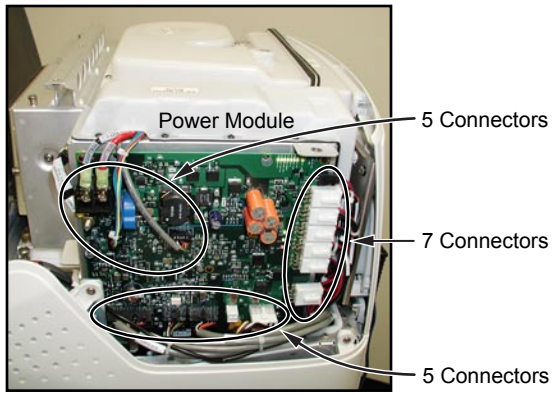

Figure 3-9 Power Module

11. Remove Display Arm Assembly

This instruction will be written in the next version of the service manual.

12. Remove Rear Panel From Display Assy

12.1 Remove nine setscrews from periphery of display's rear panel.

12.2 Remove rear panel from display. Several display panel components are now exposed (see Figure 3-10).

13. Remove Touch Screen

13.1 Remove rear panel (step 12).

13.2 Disconnect cable from J5 on Display Interface PCB (see Figure 3-10).

13.3 Disconnect cables from IR sensors.

13.4 With one hand securing front display panel to the frame, remove four setscrews securing display panel (screws are labeled A in Figure 3-10). Carefully remove panel and touch screen from frame.

CAUTION

Touch screen is not secured when the four setscrews are removed from display panel. Do not drop.

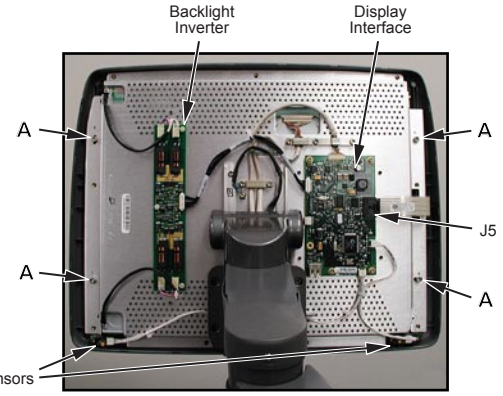

Figure 3-10 Display Assembly With Rear Panel Removed

14. Remove LCD

14.1 Remove touch screen (step 13).

14.2 Disconnect cable W12 from rear of LCD (see Figure 3-11).

14.3 Disconnect four cable connectors from Backlight Inverter.

14.4 With one hand securing LCD to the frame, remove four setscrews securing LCD (screws are labeled B in Figure 3-11).

14.5 Carefully remove LCD from frame.

15. Remove SD-RAM Card Reader

15.1 Remove Rear Panel (step 12).

15.2 Remove four setscrews securing cover over SD-RAM reader (circled in Figure 3-11).

15.3 Disconnect cable W4 from card reader (see Figure 3-12).

15.4 Remove two setscrews securing card reader to frame, and remove card reader.

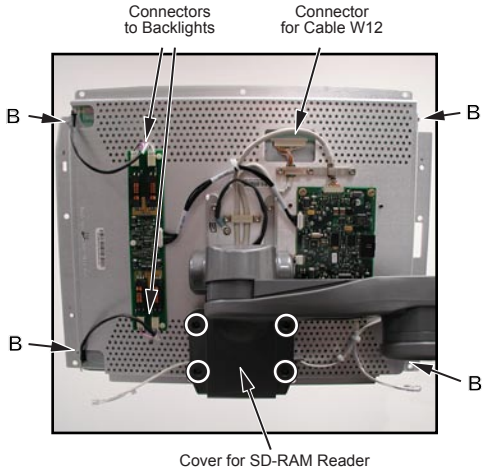

Figure 3-11 Removing the LCD

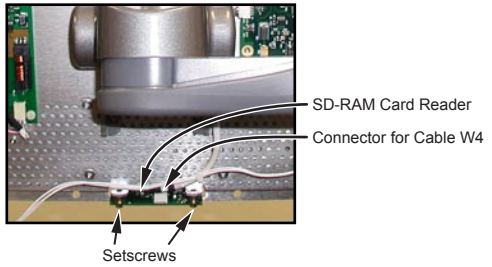

Figure 3-12 Removing SD-RAM Card Reader

16. Remove Front Panel from Tabletop Console

16.1 Remove top cover (step 1).

16.2 Press in and release tabletop filter tray to eject it from latch mechanism (see Figure 3-13). Remove filter tray.

16.3 Remove two setscrews exposed at bottom corners of front panel, and two captive setscrews at upper corners of front panel (all four screws circled in Figure 3-13).

16.4 Remove front panel.

Figure 3-13 Remove Front Panel

17. Remove Tabletop Illuminator Module

17.1 Press Eject button on tabletop rear panel to release Illuminator Module.

17.2 Slide Illuminator Module out from system.

18. Remove Fluidics Module

18.1 Remove front panel (step 16).

18.2 Loosen three captive setscrews securing Host Module to tabletop frame (see Figure 3-2). Tilt Host up and towards back of system.

18.3 Loosen four captive setscrews on front of Fluidics Module (see Figure 3-14).

18.4 Slide Fluidics Module forward to gain access to its rear panel connectors.

18.5 Use 11/16" wrench to remove Pneumatic tubing from back of module.

18.6 Disconnect W34 (power), W24 (ethernet), and W26 (slot ID) cables from back of module.

18.7 Slide Fluidics Module out from system.

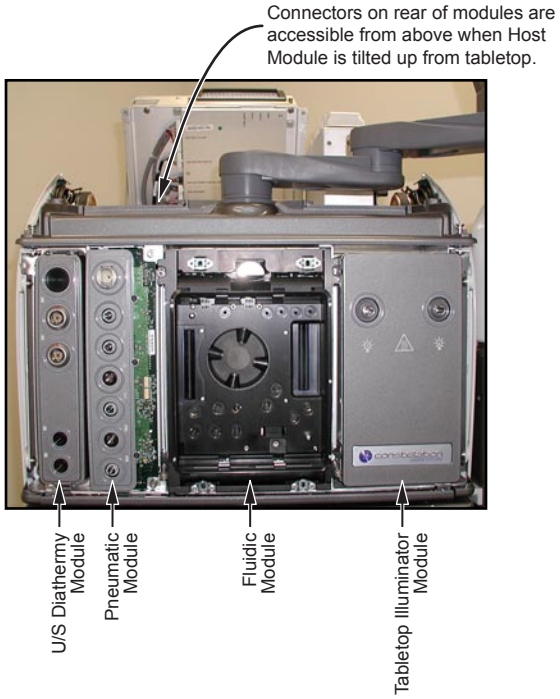

Figure 3-14 Modules With Front Panel Removed

19. Remove Pneumatic Module

19.1 Remove front panel (step 16).

19.2 Loosen three captive setscrews securing Host Module to tabletop frame (see Figure 3-2). Tilt Host up and towards back of system.

19.3 Loosen two captive set screws at front of Pneumatic Module (see Figure 3-14).

19.4 Slide Fluidics Module forward to gain access to its rear panel connectors.

19.5 Disconnect red and blue pneumatic tubes from rear of module.

19.6 Disconnect W32 (power), W21 (ethernet), and W26 (slot ID) cables from back of module.

19.7 Disconnect pneumatic pressure hose from rear of module (11/16" wrench).

19.8 Slide Pneumatic Module out from system.

20. Remove U/S Diathermy Module

20.1 Remove front panel (step 16).

20.2 Loosen three captive setscrews securing Host Module to tabletop frame (see Figure 3-2). Tilt Host up and towards back of system.

20.3 Loosen four captive setscrews on front of U/S Diathermy Module (see Figure 3-14).

20.4 Slide U/S Diathermy Module forward to gain access to its rear panel connectors.

20.5 Disconnect W30 (power), W20 (ethernet), and W26 (slot ID) cables from back of module.

20.6 Slide U/S Diathermy Module out from system.

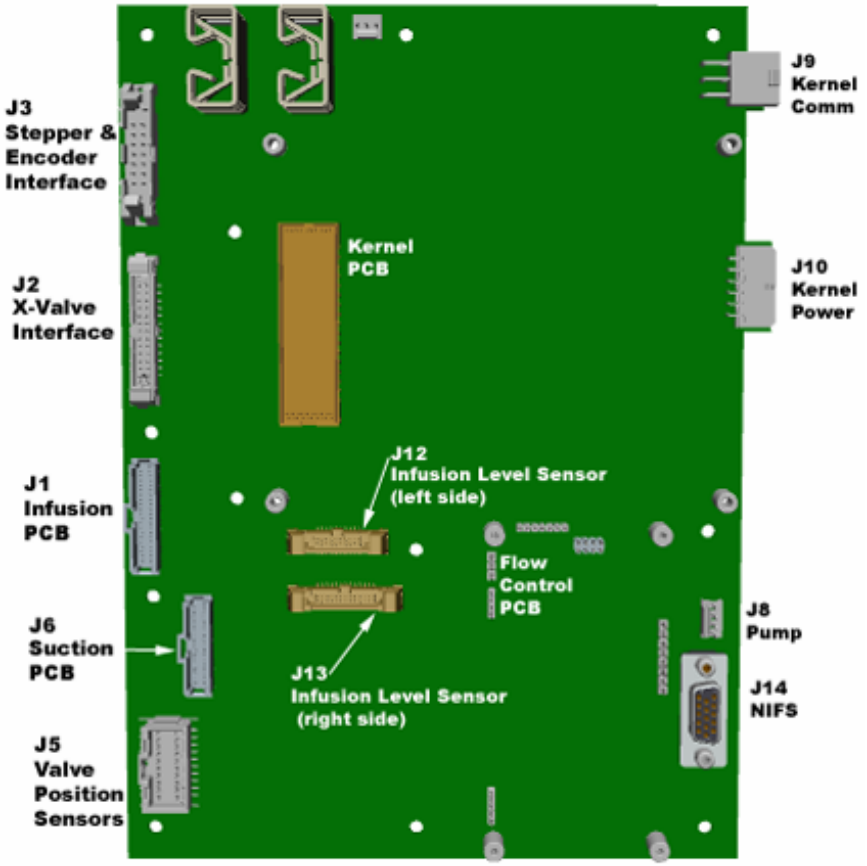

Figure 3-15 Fluidics PCB Locator Diagram

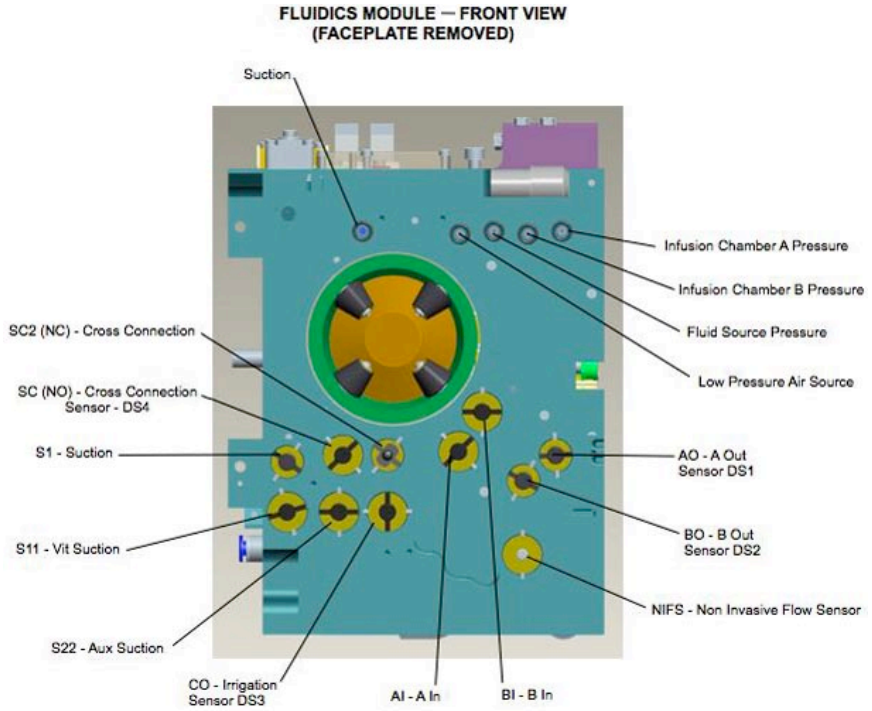

Figure 3-16 Fluidics Module Locator Diagram 1

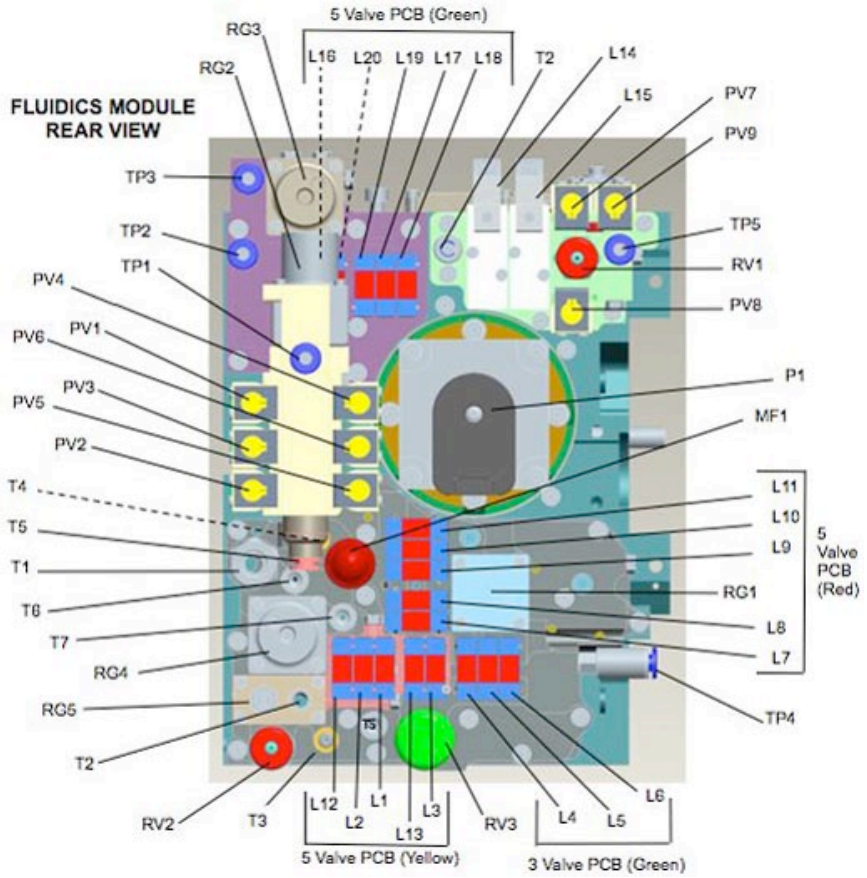

Figure 3-17 Fluidics Module Locator Diagram 2

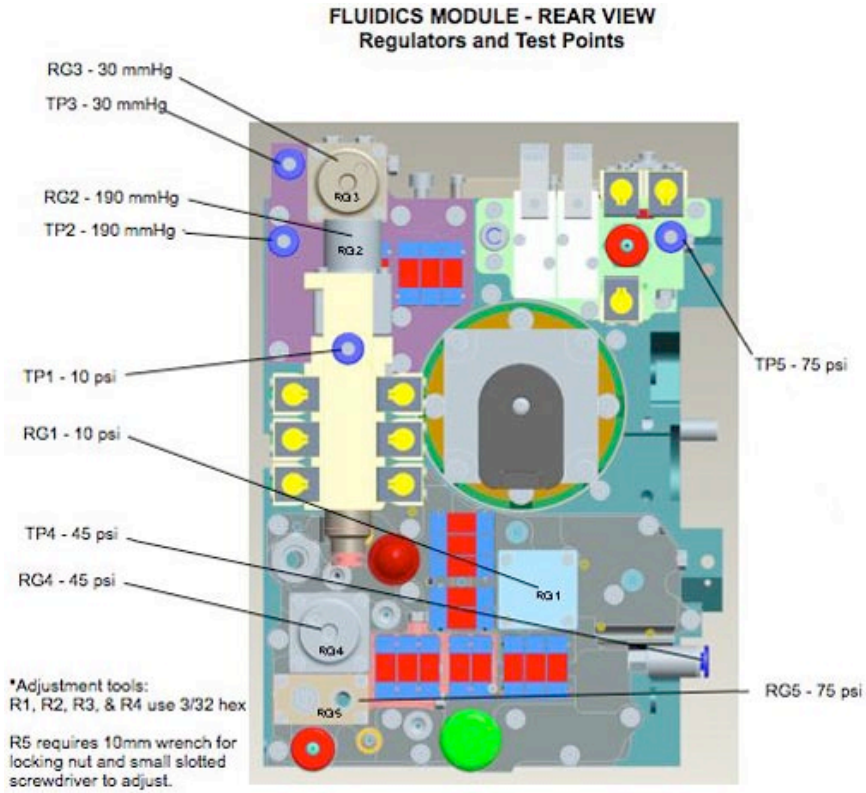

Figure 3-18 Fluidics Module Locator Diagram 3

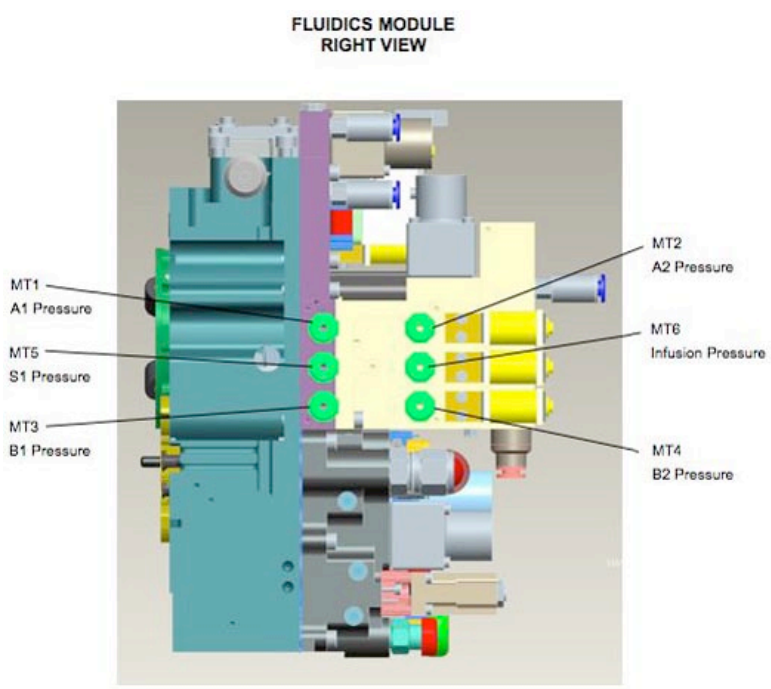

Figure 3-19 Fluidics Module Locator Diagram 4

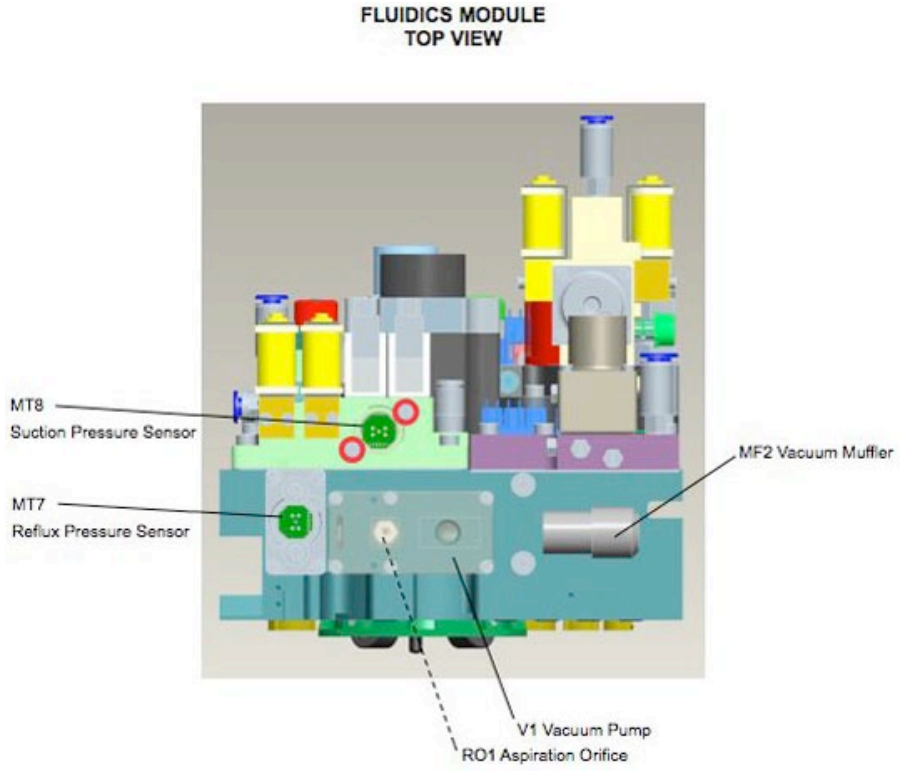

Figure 3-20 Fluidics Module Locator Diagram 5

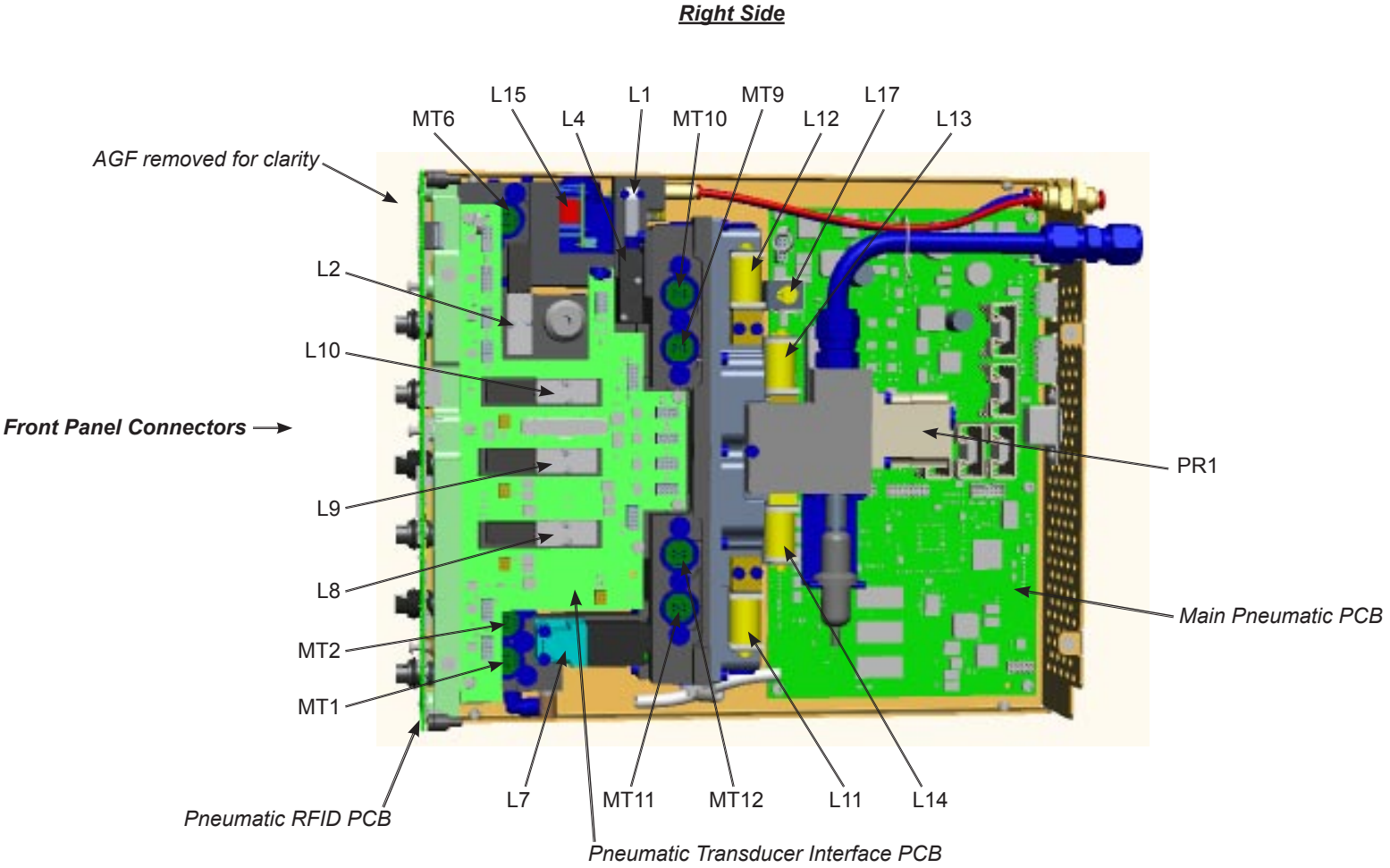

Figure 3-21 Pneumatic Module Locator Diagram 1

Left Side

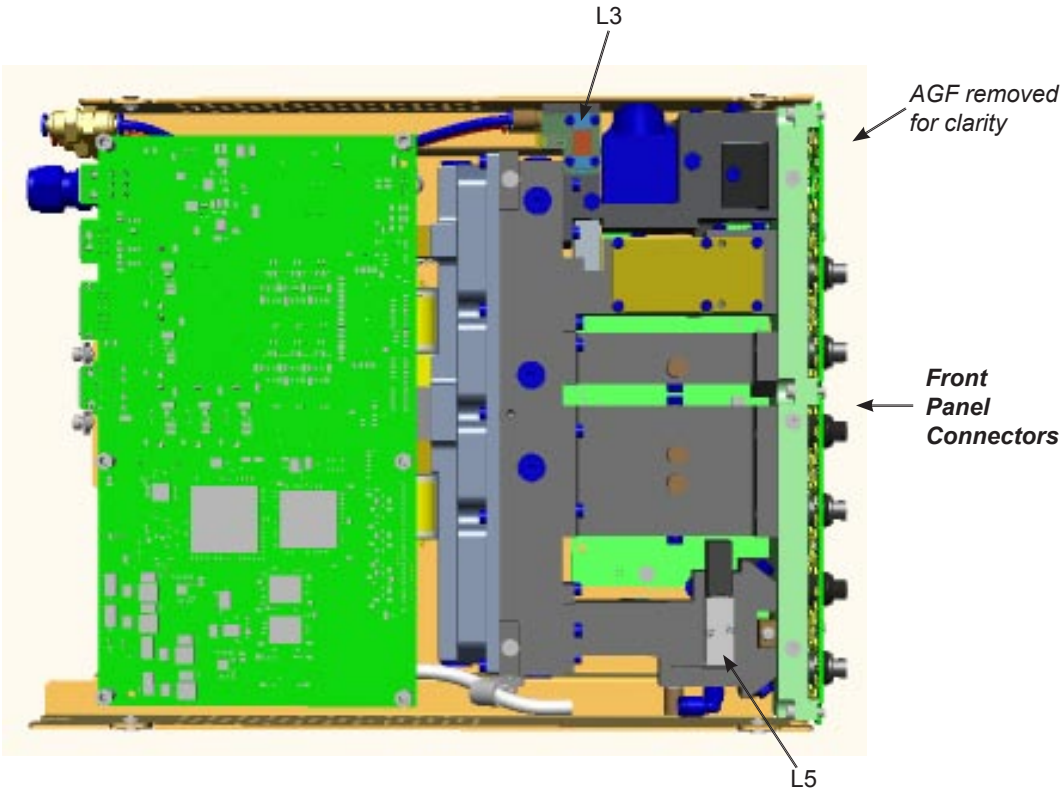

Figure 3-22 Pneumatic Module Locator Diagram 2

Top View

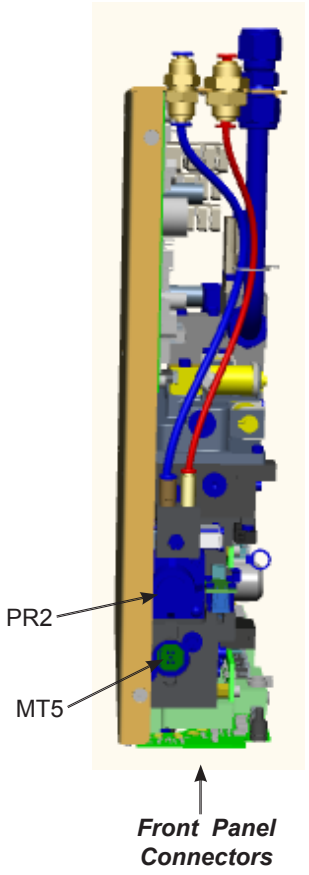

Figure 3-23 Pneumatic Module Locator Diagram 3

SECTION FOUR
MAINTENANCE AND TROUBLESHOOTING

GENERAL INFORMATION

This section of the manual contains information to assist the Field Engineer in maintenance, troubleshooting, and repair of the *Constellation®* World Phaco System.

CAUTION

The *Constell*ation® system contains electrostatic discharge (ESD) sensitive devices. Always wear a wrist strap when working with this device.

Description	Part Number	Quantity
Standard Tools		
Standard Tool Set	N/A	1
• Screwdriver set, Allen Hex Wrench set, T Handle Hex Wrench set, Rachet and Socket set with Extensions, Metric Box/Open Wrench set, Pliers set.		
• Large Adjustable or 11/16" Open End Wrench (for Internal Pneumatic Connections).		
Special Tools and Test Supplies		
Video Capture Box (includes WinTV)	N/A	1
Video Converter Box (includes video cables)	N/A	1
Null Modem Cable	N/A	1
Audio Cable	N/A	1
Tubing and fittings required for Pressure tests	N/A	1
SD Memory Card (minimum 1Gb)	N/A	1
Phaco Handpiece	8065750121	1
25 ga Combined Procedure Pak	8065751071	1
Consumables connectors for RFID tests	N/A	1 each
Cautery Load box	N/A	1
Digital Pressure Meter (DPM)	N/A	1
Transducer Test Box	N/A	1
Power Meter	N/A	1
Power Head	N/A	1
Safety Glasses	N/A	1
20 Ga Illumination Probe	8065812001	1
Caster Wrench	N/A	1
Extender Cables	N/A	1
Pneumatic Tubing Extension	N/A	1
Scopemeter & 10:1 Probe	N/A	1

Table 4-1 Recommended Tools and Test Supplies

SERVICE TEST PROCEDURE

Each time a field engineer works on a system it is required that system checkout is performed. The checkout is performed by following instructions written in the Service Test Procedure (STP), then returning its associated checklist to the local service support center for filing.

The STP/Data Sheet is an independent document, and can be ordered from the local service support center.

Description	Part Number
Fluidics Module	212-1445-501
Air Distribution Module	212-1040-501
Power Control Module	212-1016-501
Tabletop Illuminator	212-1047-501
Pneumatics Module	212-1023-501
U/S Diathermy Module	212-1037-501
Display Module	212-1003-501
Illuminator Latch	212-2187-501
Host Module	212-1010-502
Supervisor	212-2947-501
PCB 3 Valve, Green	212-2534-501
PCB, 5 Valve, Yellow	212-2785-501
PCB, 5 Valve, Red	212-2786-501
PCB, 5 Valve, Green	212-2787-501
Agf Coaxial Connector	212-2730-001
Antenna, W1F1	276-339
Aspiration Level Sensor	212-3055-501
Assy, Arm, Display	212-1003-501
Assy, Articulating Arms, Display	212-1220-501
Assy, Cable, W01, Foot Switch	212-1678-001
Assy, Display, LCD 17 In	212-1132-501
Assy, Host, Service	212-1010-502
Assy, PCB, Aux Illum Floating	212-2368-501
Assy, PCB, Display Interface	212-1794-501
Assy, PCB, Fluidics Controller	212-2936-501
Assy, PCB, Footswitch	212-1480-501
Assy, PCB, Home Sensor	212-2413-501
Assy, PCB, Host Display Conn	212-1796-501
Assy, PCB, Illum RFID Cont	212-1630-501
Assy, PCB, InterFace Breakout	212-1727-501
Assy,Base, Switch	212-1646-501
Assy,Manifold,ASP Fluidics	212-2154-501

Description	Part Number
Assy,PCB,Illum Cable I/F	212-1974-501
Assy,PCB,Stand-By Switch	210-1626-501
Assy,Pincher,NIF	212-2282-501
Aux Illuminator Controller PCB	212-1808-501
Base Power Distribution	212-2164-501
Battery,Lithium,3v 220mah Coin	190-022
Cable Assy, W47, Footswitch	212-1666-001
Dc/Dc Conv PCB	212-1203-501
Fluidics Infusion PCB	212-1472-501
Fluidics Suction PCB	212-1473-501
Infusion Manifold	212-2172-501
Lower Expansion	212-1869-501
NIFS Sensor Assy	212-2251-501
PCB Assy,Video Overlay	212-2304-001
PCB Extender	212-2665-501
PCB, AC Power Distribution	212-1822-501
PCB, Bottom Power Distribution	212-1512-501
PCB, Fluidics, Cass ID	212-1530-501
PCB, IR Sensor	210-1655-503
PCB, Power Controller	212-1511-501
PCB, SD Card Reader Control	212-1834-501
PCB, Sensor, Flow	212-2316-001
PCB, U/S-Diat-Aqua Module	212-1231-501
Pneu Locking Female Connector	212-1390-001
Pneu Locking Male Connector	212-1389-001
Pneum RFID PCB	212-1621-501
Pneumatics Main Controller PCB	212-2672-501
Power Bracket Connector	212-2714-501
Transducer Intf PCB	212-2710-501
Tray Arm	212-1004-501
TT Floating Conn	212-2360-501
Upper Expansion	212-1868-501

Table 4-2 Service Spare Parts

POWER UP SEQUENCE

1. With power cord plugged into AC outlet, turn On/Off rocker switch/breaker, located on rear of table top, to the ON position. The Power Controller PCB receives 12 V from the 900 W power supply and converts/sends 5 V / 100 mA to the standby switch; its button illuminates amber.
2. Press the amber standby button to begin powering up the system. The button turns blue to indicate the boot sequence has begun.
3. The Power Controller PCB sends the PS enable signal to the 900 W power supply to allow 24 V to go through the battery charger to the 18 V Li-Ion battery and back to the Power Controller PCB which then delivers 24 V to the Host ATX DC/DC PCB through J4.
4. The ATX DC/DC PCB sends -12 V, +5 V, +3.3 V to the Motherboard. It also sends +12 V to the Display Module through the Display Interface PCB.
5. After a few minutes, the Host Module sends a message back to the Power Controller PCB through J6, triggering +24 V 900 W power supply to the table top modules and supervisor.
6. After the table top modules successfully report back to the Supervisor, and if Table Top is connected to a Base unit, a Host signal triggers the delay switch which allows AC power to enter the Base 650 W power supply and its modules.
7. Once Table Top modules (and Base modules, if present) report back to the Supervisor, the Supervisor sends a message through the ethernet indicating it has taken control.

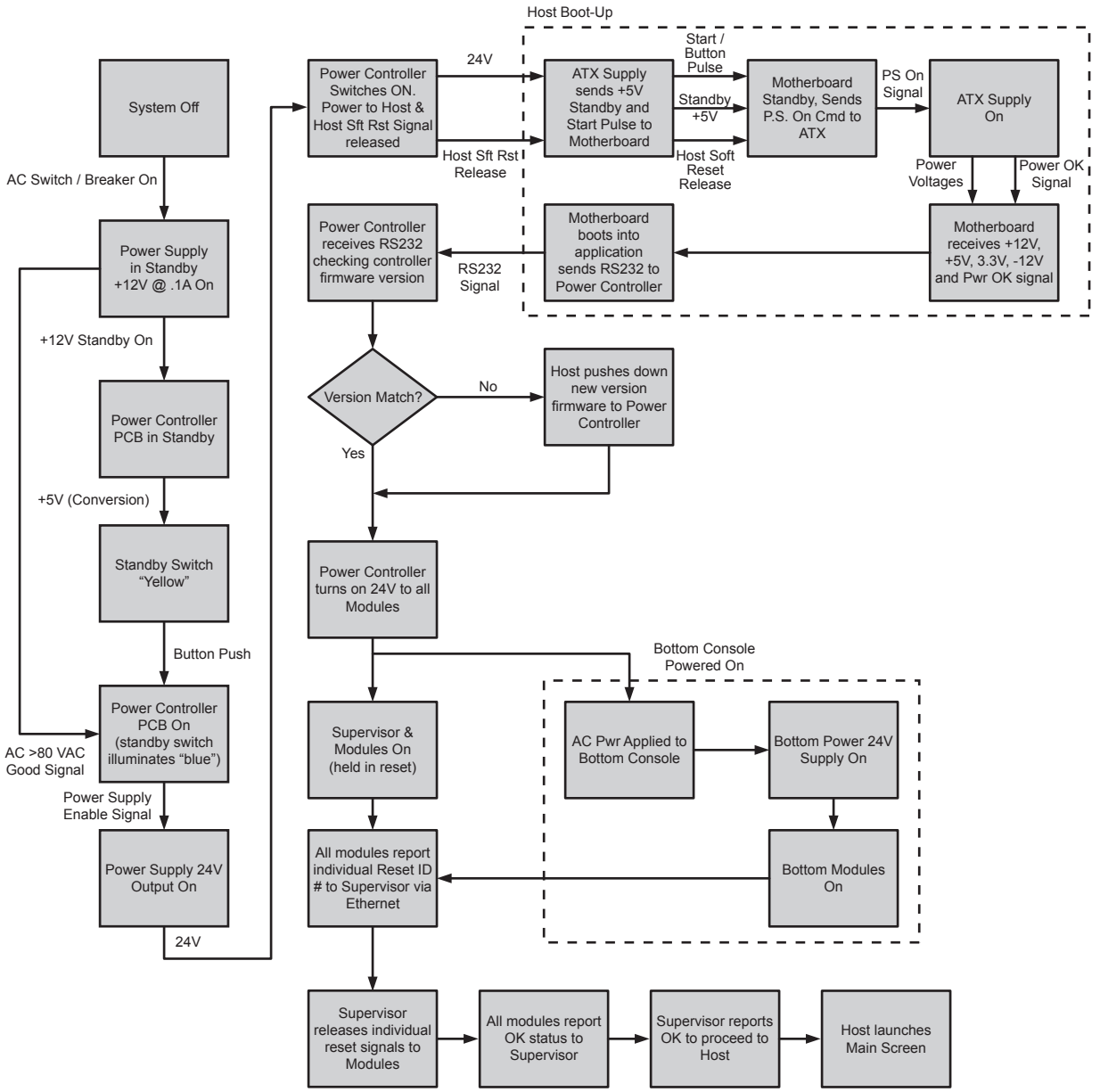

Figure 4-1 Power Up Sequence

PRESSURE HOSE SETUP

The pressure hose is shipped in a configuration compatible with some facility air pressure source fittings; however, a BSPT-to-NPT adapter is packaged with the hose assembly to accommodate a facility with an NPT fitting at the pressure source. The shipped configuration is shown in Figure 4-2.

Notes:

- **To ensure proper function of system, all pressure source fittings and hoses must have a minimum 1/4" inside diameter. If smaller diameter fittings are use in conjunction with the inlet hose fittings, degradation of performance will be experienced at minimal inlet pressures (58.8 psig/ 4 bar).**
- **All fittings on Alcon-supplied components are BSPT except for the BSPT-to-NPT adapter.**
- **Use thread sealant when connecting fittings.**

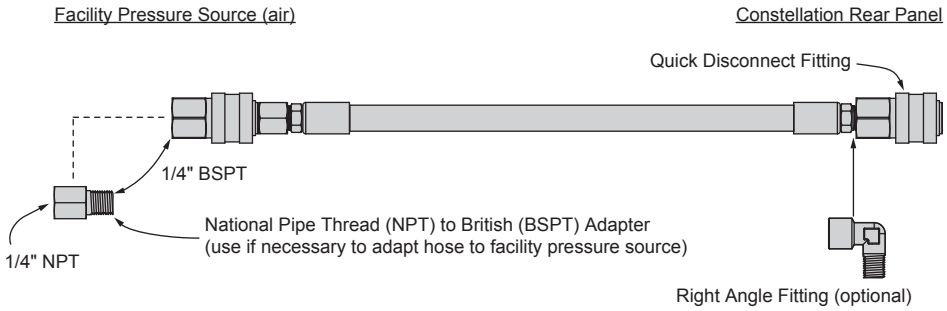

Figure 4-2 Shipped Configuration (for AIR pressure source)

Air Pressure Source Configuration

To connect the *Constellation*® System to a facility air pressure source, perform the following steps (see Figure 4-2).

1. Determine if facility has a BSPT or NPT fitting.
   - For BSPT fitting, no change is required; use pressure hose as shipped.
   - For NPT fitting, connect BSPT-to-NPT adapter to fitting on hose.
2. Connect threaded end of hose to facility air pressure source.
3. Connect quick disconnect fitting to rear panel of *Constellation*® System. If desired, a right angle fitting, included with hose assembly, may be added where shown.

Nitrogen (N_2) Pressure Source Configuration

To use a nitrogen pressure source, the fittings on the shipped hose configuration must be changed as instructed below (see Figure 4-3).

1. Remove connectors from both ends of hose.
2. Connect supplied NIST N_2 fitting to BSPT fitting on hose.
3. Remove female quick disconnect fitting from other end of hose.
4. Remove male quick disconnect fitting from rear panel of system.
5. Connect hose assembly to rear panel of system.
6. Connect hose's NIST N_2 fitting to facility's N_2 pressure source.

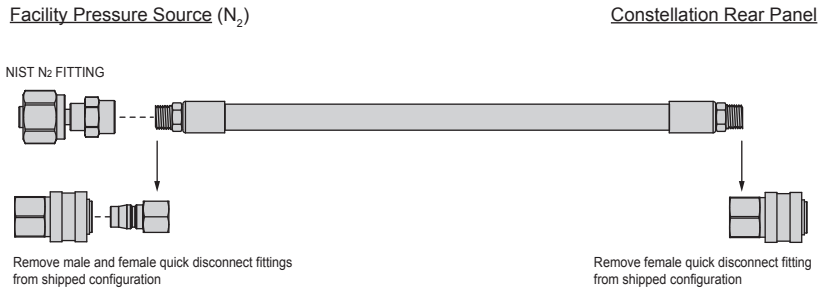

Figure 4-3 Modified Configuration (for N_2 pressure source)

REPLACE ILLUMINATOR LAMP

The *Constellation*® System's xenon arc lamp is specified to last 400 hours in normal usage. Some possible indications that the lamp needs to be replaced are listed here:

- A message appears on the display stating that the lamp should be replaced.
- Repeated failure to ignite lamp.
- Flickering of output light.
- Insufficient light output.

WARNINGS!

- **Burn hazard exists. Do not remove lamp immediately after operation. The lamp temperature may be above 100˚ C. Allow lamp to cool for a minimum of five minutes before handling.**
- **Handle the lamp carefully when installing and/or uninstalling from the unit in order to prevent touching the glass to adjacent components.**
- **Do not touch the bulb glass. Contaminants from hands can cause the lamp glass to crack during use.**
- **Use eye protection when installing and uninstalling lamps. The lamp is pressurized and presents an explosion hazard if it is damaged and/or dropped, or if the glass envelope of the bulb is punctured.**
- **Do not drop the lamp.**
- **Always store the lamp in its protective housing when it is uninstalled from the unit.**

Removal

1. Extinguish lamp and wait a minimum of five minutes for lamp to cool.
2. Press ejection button on the back of tabletop or base (see Figure 4-4).
3. Pull illuminator assembly out to its full extension (see Figure 4-5).
4. Turn latch on top of illuminator 90° CCW (see Figure 4-6) and lift door up to its limit (see Figure 4-7).
6. Lift up on green bar of lamp clamp until it contacts door.
7. After waiting for lamp to cool, carefully lift lamp straight up and out of lamp chamber (see Figure 4-8).
8. Place lamp in its white plastic protective cover (see Figure 4-9).

Replacement

1. Remove new lamp from its shipping box.
2. Remove white plastic protective cover from lamp (see Figure 4-9).
3. Carefully insert the new lamp into socket in lamp chamber and push down on lamp until lamp clamp is vertical (see Figure 4-10).
5. Push down on lamp clamp until it is horizontal (see Figure 4-11).
6. Close illuminator door and push down on door latch while rotating it 90° CW.
7. Push illuminator assembly back into tabletop or base with sufficient force to engage latch.
8. Save white plastic protective cover and shipping carton for future lamp disposal.

Lamp disposal on next page


Figure 4-4


Figure 4-5


Figure 4-6

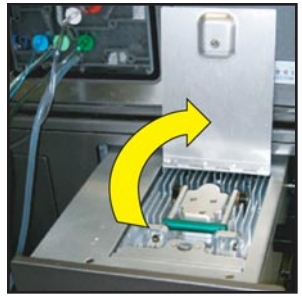
Figure 4-7


Figure 4-8

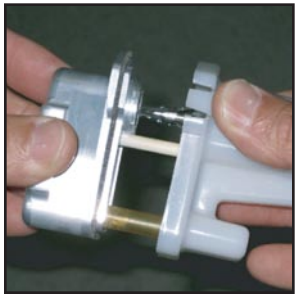
Figure 4-9

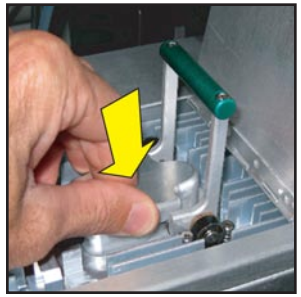
Figure 4-10


Figure 4-11

Lamp Disposal

1. Place supplied cable tie around base of lamp and white plastic protective cover to ensure they stay together (see Figure 4-12).
2. Place lamp on edge of a hard, stable surface and strike center of white plastic protective cover with a hammer or other tool with sufficient force to break glass and depressurize lamp (see Figure 4-13).
4. Place discharged lamp with its protective cover in shipping box.
5. Dispose of carton in a standard trash receptacle.

Figure 4-12

Figure 4-13

REPLACE CPC CONNECTORS

There are three types of CPC connectors on the front panel of the Pneumatic Module: male, female, and coaxial (see Figure 4-14). The male and female pneumatic locking connectors are easily removed by inserting either a 3/32" or 1/8" hex wrench into the center of the connector and turning CCW. To replace, follow the instructions below.

1. Add a light coating of locking adhesive to threads of CPC connector (see Figure 4-15).
2. Place connector on hex wrench and insert connector into front connector panel.
3. Turn connector CW with hex wrench until it takes hold, then press and wiggle connector with your fingers until alignment ears click into their slots (see Figure 4-15).
4. Firmly tighten CPC connector with hex wrench.

The top AGF coaxial connector can be removed after removing Pneumatic Module from system.

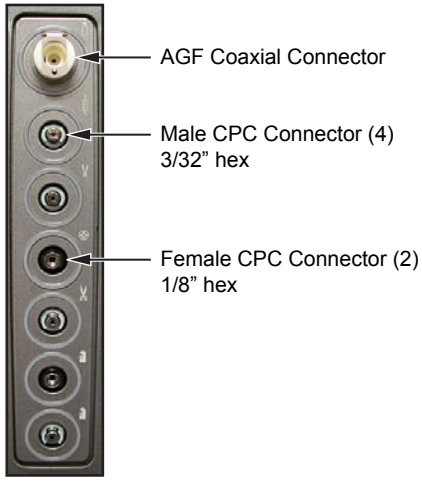

Figure 4-14

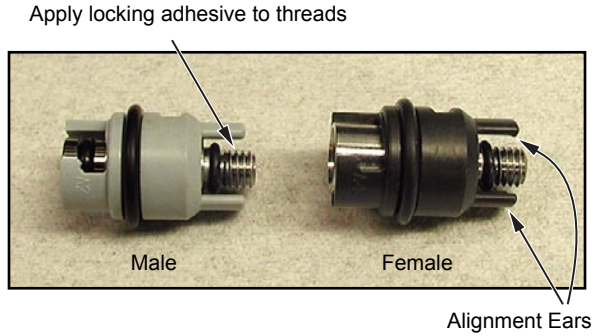

Figure 4-15

DISASSEMBLE ILLUMINATOR ASSYS

Disassemble Table Top Illuminator

1. Remove nine 2 mm screws securing chassis top cover. Remove cover.

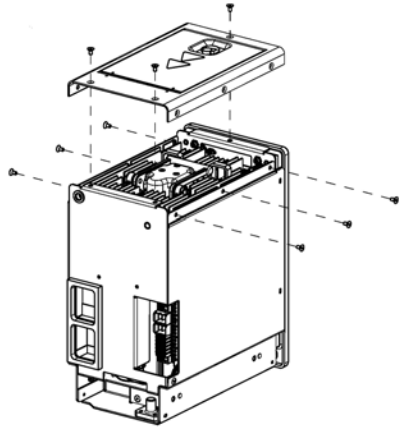

Figure 4-16

2. Remove two 2.5 mm screws from under chassis, and two 2 mm screws from chassis top, and remove front cover.

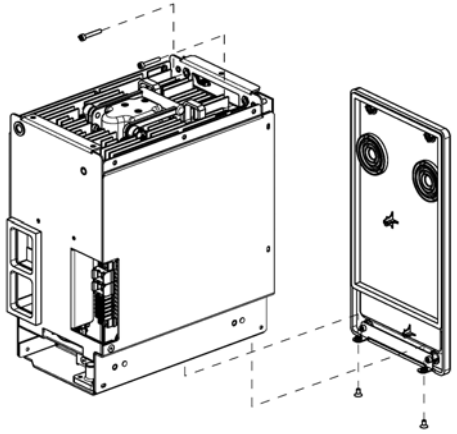

Figure 4-17

3. Remove three phillips screws and remove latch bracket.

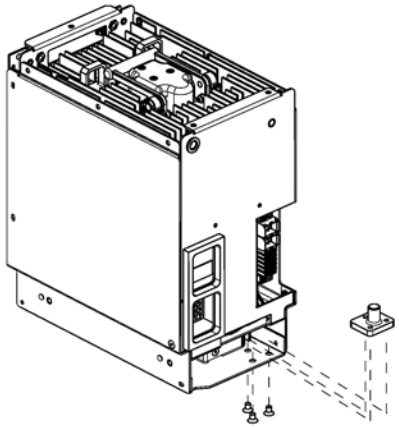

Figure 4-18

4. Remove two 2 mm screws from rear of chassis. Remove rear chassis panel.

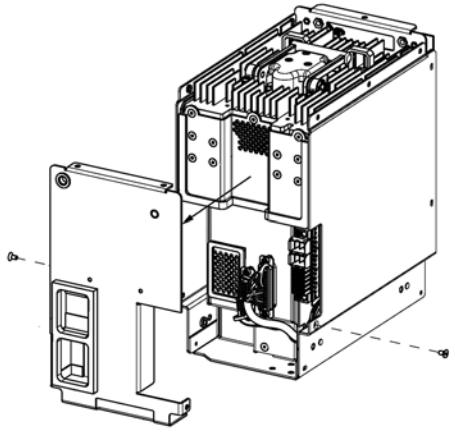

Figure 4-19

5. Remove four 3 mm screws securing RFID PCB to front of chassis. Disconnect three cables and remove RFID PCB.

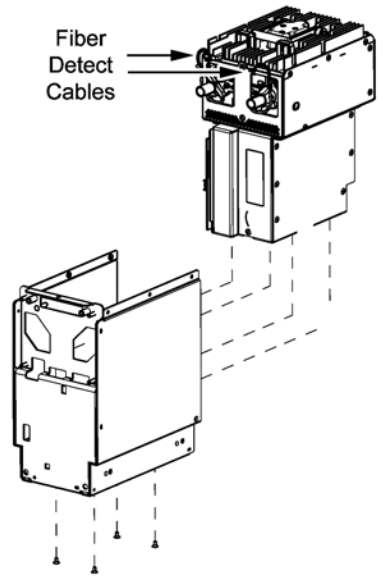

Figure 4-20

6. Remove four screws from under chassis. Remove chassis.

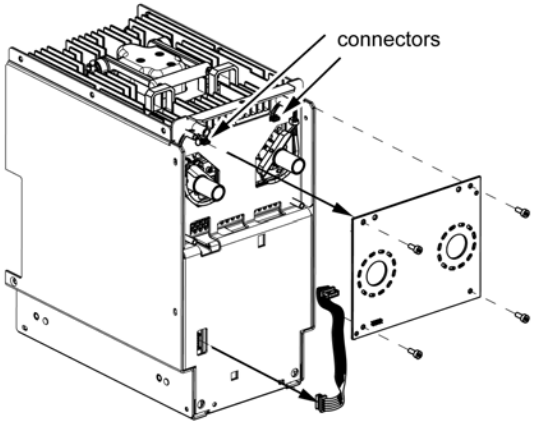

Figure 4-21

7. Remove four 2 mm screws securing connectors at rear of power supply. Disconnect two cables at both ends and remove.

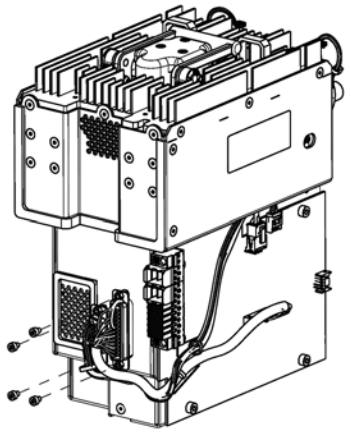

Figure 4-22

8. Remove four 3 mm screws securing Illumination Control PCB to power supply. Remove Illumination Control PCB.

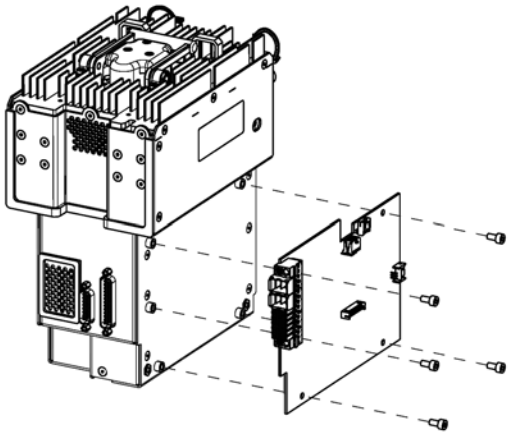

Figure 4-23

9. Remove eight 2 mm screws securing power supply to optics block. Separate the two and carefully remove optics block. • • • •

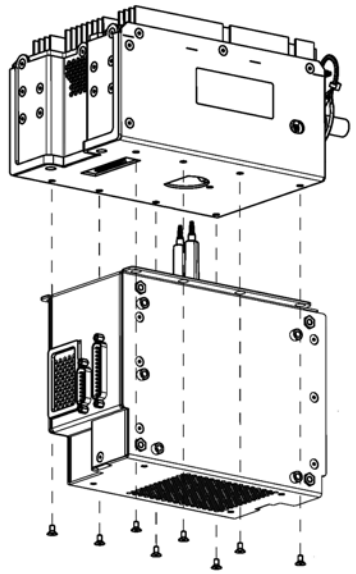

Figure 4-24

Disassemble Auxillary Illuminator

1. Remove six 2 mm screws securing top cover to chassis. Remove cover.

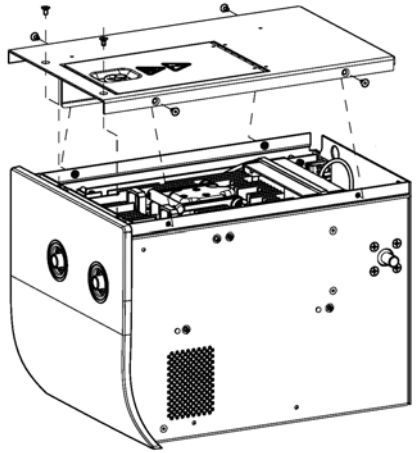

Figure 4-25

2. Remove two 2 mm screws from sides, and two 2.5 mm screws from top of chassis. Remove front panel.

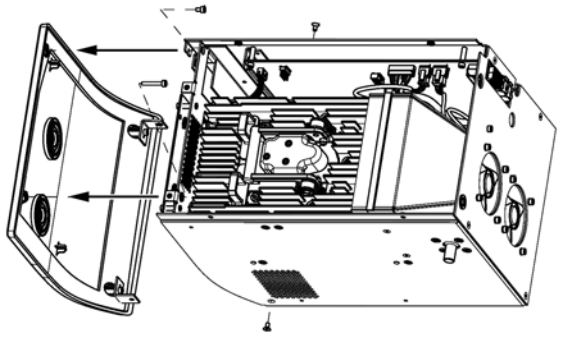

Figure 4-26

3. Remove five screws (2 mm and 2.5 mm) securing rear panel to chassis. Pull panel away slightly to access and disconnect two fan cables. Remove rear panel.

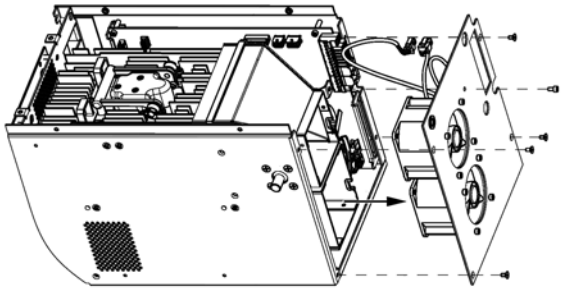

Figure 4-27

4. Remove two 2 mm screws from side of chassis, and pull the vent duct out and away.

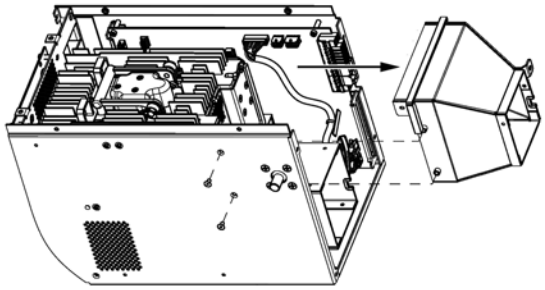

Figure 4-28

5. Remove three 2.5 mm screws securing lower duct. Remove lower duct.

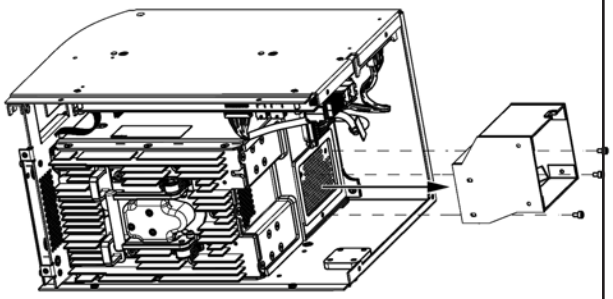

Figure 4-29

6. Remove four 2.5 mm screws securing two cable connectors to back of power supply. Disconnect both ends of cables and remove from chassis.

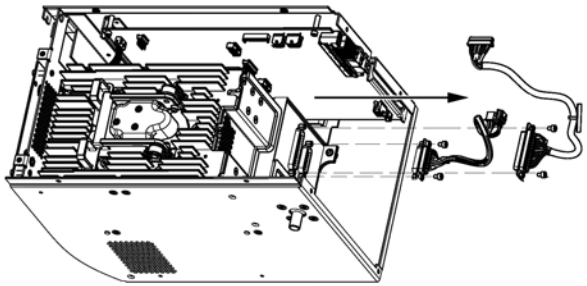

Figure 4-30

7. Remove four 2.5 mm screws securing RFID PCB to front of chassis. Disconnect cable from Illuminator Control PCB, and remove RFID PCB.

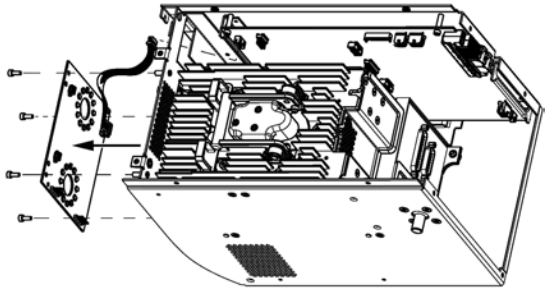

Figure 4-31

8. Remove three 3 mm screws securing Illuminator Control PCB to chassis. Remove Illuminator Control PCB.

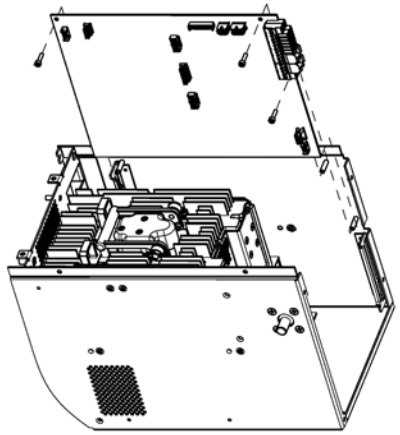

Figure 4-32

9. Remove three 2 mm screws from under chassis, pull chassis frame away and remove.

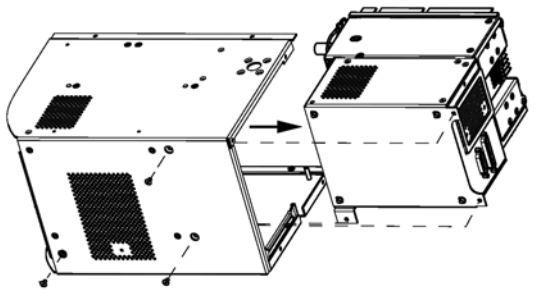

Figure 4-33

10. Remove four screws securing power supply to Optics Block assembly.

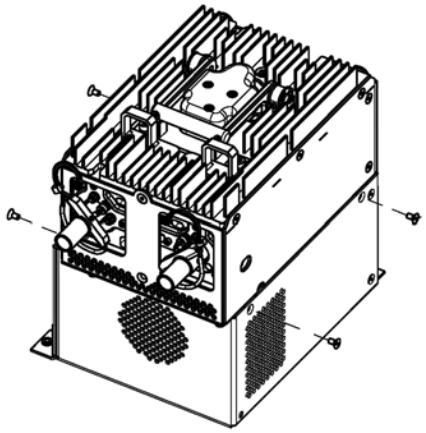

Figure 4-34

11. Carefully separate power supply from Optics Block (to gain access) and disconnect ribbon cable. Remove one 2.5 mm screw securing high-voltage connector to Optics Block. Remove connector from Optics Block and set block aside in a clean area. • • • •

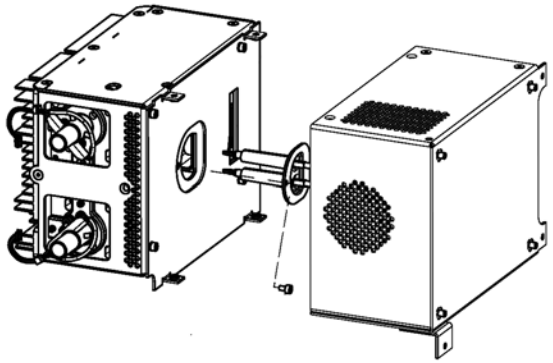

Figure 4-35

Disassemble Optics Module

1. Remove one 2 mm screw and remove fiber detector cable from output port. Repeat for second port.

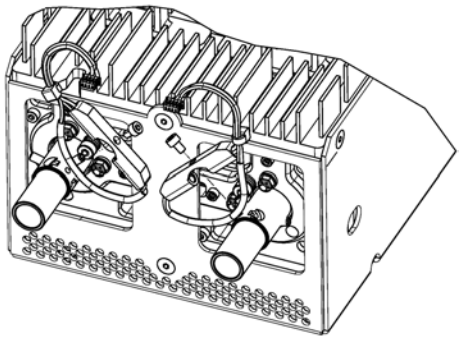

Figure 4-36

2. Remove two 3 mm screws securing filter brackets. Remove brackets.

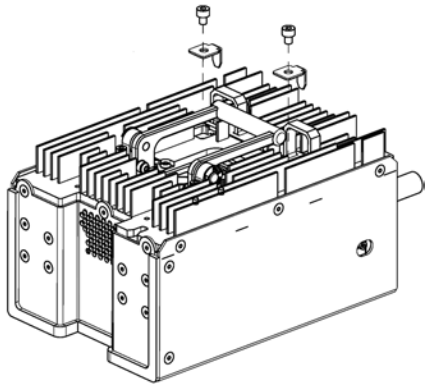

Figure 4-37

3. Remove both filter carriers.

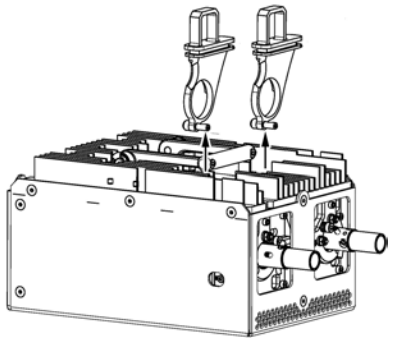

Figure 4-38

4. Remove the nine 2 mm screws securing rear panel. Remove rear panel.

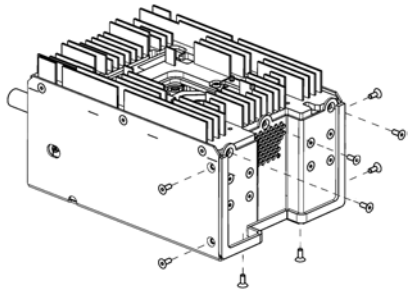

Figure 4-39

5. Remove eight 2 mm screws securing base cover to chassis. Remove base cover.

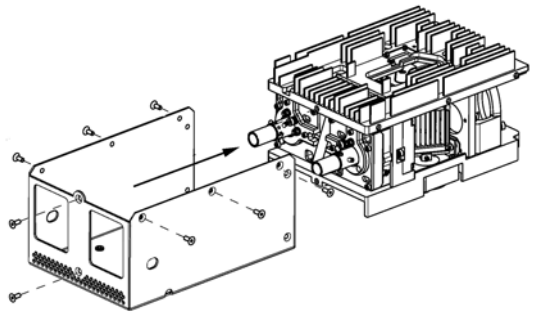

Figure 4-40

6. Remove five 2 mm screws securing top cover/ heat sink. Remove heat sink.

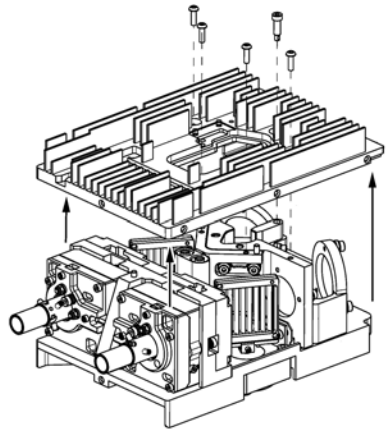

Figure 4-41

7. Remove three 2 mm screws securing HV receptacle to chassis. Remove HV receptacle.

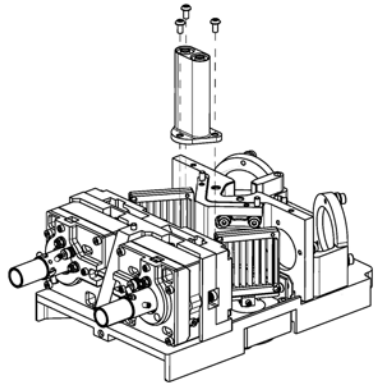

Figure 4-42

8. Loosen 1.5 mm setscrew securing attenuator to stepper motor shaft. Ensure that gap in attenuator vane clears opto-sensor, and remove attenuator.

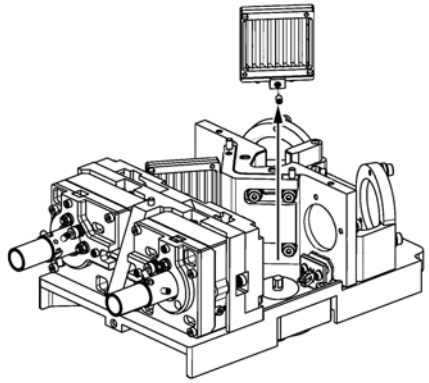

Figure 4-43

9. Remove two 3 mm screws securing stepper motor to underside of chassis. Remove stepper motor.

Repeat steps 8 and 9 as required for other attenuator/motor.

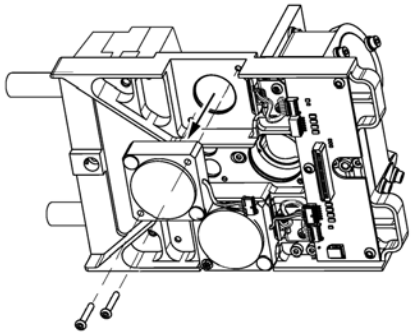

Figure 4-44

10. Disconnect thermistor cable from Interface PCB at J6. Unscrew thermistor from chassis and remove.

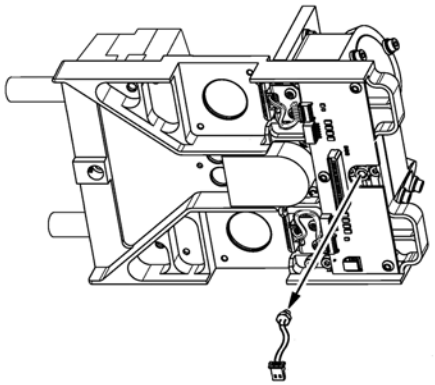

Figure 4-45

11. From under chassis, disconnect attenuator sensor cables from front of Interface PCB. From top, remove 2 mm screw from thermal switch and carefully bend leads up to allow removal of Interface PCB.

    Remove three 2 mm screws securing Interface PCB to bottom of chassis. Remove Interface PCB. • • • •

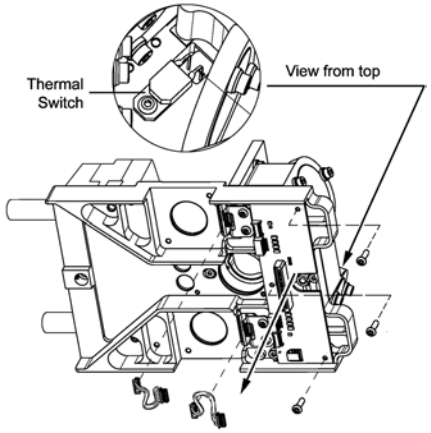

Figure 4-46

FAULTS, ERRORS, ADVISORIES, AND INFORMATION MESSAGES

System discrepancies are classified as Faults, Errors, Advisories, and Information, in order of severity.

The display of Faults has priority over Errors, and Errors have priority over Advisories, which have priority over Information messages. When more than one discrepancy exists within any one classification, the first discrepancy is displayed.

Faults

Discrepancies which require system shutdown are classified as Faults. When a fault condition is detected, the following actions are performed:

- All functions are placed in a safe state.
- The fault tone is activated.
- The fault message is displayed with a red background.
- All requests for functions are ignored, including button closures.

Errors

Discrepancies that require partial system shutdown, and can't be reversed until the next power cycle, are classified as Errors. When an Error condition is detected, the following actions are performed:

- Affected functions are placed in a safe state.
- The error tone is activated.
- The error message is displayed with a yellow background.
- Requests for affected functions, including button closures, are ignored until the error condition no longer exists or the operator acknowledges the error by pressing the dedicated button.

Advisories

When an Advisory condition exists, the operator is informed of a condition that requires corrective action. When an Advisory condition is detected, the following actions are performed:

- The advisory tone is activated.
- The advisory message is displayed with a green background.

Advisory messages are displayed until the condition no longer exists, the condition no longer applies to the current operating mode, or a dedicated button has been pressed to acknowledge the advisory. Advisory messages that only present a single user response button may be configured to automatically fade away. A fading advisory message is displayed for 20 seconds, after which, in the absence of a user response, it fades away.

Information

When an Information condition exists, the operator is informed of the useful information. When an Information condition is detected, the following action is performed:

- The information message is displayed with a blue background.

Information messages are displayed until the condition no longer exists, the condition no longer applies to the current operating mode, or a dedicated button is pressed to acknowledge the message. Information messages that only present a single user response button may be configured to automatically fade away. A fading information message is displayed for 20 seconds after which, in the absence of a user response, it fades away.

System Response to Discrepancies

Discrepancies in the following table are identified by a unique 4-digit decimal error code. The first digit of the error code encodes the submodule. The remaining three digits encode the discrepancy. Refer to the table below for each submodule's discrepancy code number range.

Submodule	Discrepancy Number Range	
	Start Offset	End Offset
Reserved	0	999
Host	1000	1999
Supervisor	2000	2999
Fluidics	3000	3999
US/Diathermy	4000	4999
Table Top Illuminator	5000	5999
Pnuematics	6000	6999
Auxiliary Illuminator	7000	7999
Laser	8000	8999

Faults, Errors, Advisories, and Information messages produce an appropriate popup on the display panel, and the system takes specific actions as specified in the following discrepancy tables.

Error Code	Classification	Displayed Text	Discrepancy
1001	Fault	Fault - 1001 Call Field Service	The OSE Gateway exited unexpectedly.
1002	Fault	Fault - 1002 Call Field Service	The OSE Gateway has reported that the Supervisor process has gone down.
1003	Fault	Fault - 1003 Call Field Service	Something has failed in the communication between the Host and the Supervisor.
1004	Fault	Fault - 1004 Call Field Service	The Main Application exited unexpectedly.
1005	Fault	Fault - 1005 Call Field Service	The Host Controller checksum validation failed to pass all files under its control.
1006	Fault	Fault - 1006 Call Field Service	The Host has failed to connect to the Supervisor process.
1008	Fault	Fault - 1008 Call Field Service	The Host Controller failed to launch an executable image during startup.
1009	Fault	Fault - 1009 Call Field Service	The Host Controller could not communicate with the Power Module over the serial link.
1010	Fault	Fault - 1010 Call Field Service	Component or Submodule reported an incorrect software, hardware, firmware or other.
1011	Fault	Fault - 1011 Call Field Service	Host Controller communications was lost as the result of a .NET IPC failure.
1012	Fault	Fault - 1012 Call Field Service	The Host has not received any heartbeats from the Supervisor within the required timeframe.
1013	Fault	Fault - 1013 Call Field Service	The Host has detected that the User Interface thread has not responded within the required timeframe (i.e. the UI is considered locked up).
1014	Fault	Fault - 1014 Call Field Service	The system has detected a software error.
1015	Fault	Fault - 1015 Call Field Service	The Host has received a message from the Supervisor that it doesn't recognize (this is a specific type of software error).
1016	Fault	Fault - 1016 Call Field Service	The Host application's display fonts can not be loaded.
1017	Fault	Fault - 1017 Call Field Service	A failure has occurred during the playback of an audio file.
1103	Error	Voice Activation not available.	The user tried activate voice activation, but the voice activation process could not be found.
1107	Error	Unable to load one or more language packs.	An error occurred while attempting to load a non-English language.
1108	Error	Incompatible version numbers within the Fluidics submodule. Fluidics functions will be disabled.	The Fluidics module was shut down due to an incompatible version. The log file shows exactly what version information was incompatible.
1109	Error	Incompatible version numbers within the Pneumatics submodule. Pneumatics functions will be disabled.	The Pneumatics module was shut down due to an incompatible version. The log file shows exactly what version information was incompatible.
1110	Error	Incompatible version numbers within the Ultrasound submodule. Ultrasound and Diathermy functions will be disabled.	The Ultrasound module was shut down due to an incompatible version. The log file shows exactly what version information was incompatible.
1111	Error	Incompatible version numbers within the Auxiliary Illuminator submodule. Auxiliary Illuminator functions will be disabled.	The Auxiliary Illuminator module was shut down due to an incompatible version. The log file shows exactly what version information was incompatible.
1112	Error	Incompatible version numbers within the Laser submodule. Laser functions will be disabled.	The Laser module was shut down due to an incompatible version. The log file shows exactly what version information was incompatible.
1200	Advisory	Function is not allowed when the fluidics subsystem is not functional.	The user tried to invoke a command which is only allowed when the fluidics subsystem is functional.
1202	Advisory	Function is not allowed when the Laser is in Ready Mode.	The user tried to invoke a command which is not allowed when the laser is in Ready Mode or Firing.
1203	Advisory	Function is not allowed when the footswitch treadle is down or buttons are pressed.	The user tried to invoke a command which is only allowed when the treadle is up and no buttons pressed.
1204	Advisory	Flow mode is not available until the probe or handpiece has been primed.	Flow mode is unavailable because a probe or handpiece hasn't been primed.

Table 4-3 Faults, Errors, Advisories, and Information messages

Error Code	Classification	Displayed Text	Discrepancy
1205	Advisory	Flow mode is only available for 20 gauge probes / handpieces.	Flow mode is unavailable because a non 20 gauge probe or handpiece is used.
1206	Advisory	Please prime the Vit probe.	The user presses the treadle in a Vit Step when the Vit Probe hasn't been primed.
1207	Advisory	Please connect a Phaco handpiece.	The user presses the treadle in a Phaco Step when no Phaco handpiece is connected.
1208	Advisory	Please tune the Phaco handpiece.	The user presses the treadle in a Phaco Step when the Phaco handpiece isn't tuned.
1209	Advisory	Please connect a Frag handpiece.	The user presses the treadle in a Frag Step when no Frag handpiece is connected.
1210	Advisory	Please tune the Frag handpiece.	The user presses the treadle in a Phaco Step when the Phaco handpiece isn't tuned.
1211	Advisory	Function is not allowed when the Ultrasound submodule is not functional.	The user tried to invoke a command which is only allowed when the ultrasound subsystem is functional.
1212	Advisory	Function is not allowed when the cassette is not ready.	The user tried to invoke a command which is only allowed when the cassette is ready.
1213	Advisory	Infusion must be on to use VFC Extract. Press [Ignore] to allow VFC Extract without infusion for this case.	The user presses the treadle in a VFC Extract Step when infusion is off.
1214	Advisory	Please connect a VFC syringe.	The user presses the treadle in a VFC Step when no VFC Syringe is connected.
1215	Advisory	Please connect Forceps.	The user presses the treadle in a Forceps Step when no forceps are connected.
1216	Advisory	Please connect Scissors.	The user presses the treadle in a Scissors Step when no Scissors are connected.
1217	Advisory	Please connect an AGF syringe.	The user presses the "Start" button in the Auto Gas Filling dialog when no AGF syringe has been connected.
1218	Advisory	Forceps not available during AGF: please try again when AGF is complete.	The user presses the treadle in a Forceps Step while Auto Gas Filling is in progress.
1219	Advisory	VFC not available during AGF: please try again when AGF is complete.	The user presses the treadle in a VFC Step while Auto Gas Filling is in progress.
1220	Advisory	Ejecting the cassette is not allowed while the footswitch treadle is pressed.	The user attempts to eject the cassette while the treadle is down.
1221	Advisory	Ejecting the cassette is not allowed while infusion is on.	The user attempts to eject the cassette while infusion is on.
1222	Advisory	Ejecting the cassette is not allowed while irrigation is on.	The user attempts to eject the cassette while irrigation is on.
1223	Advisory	Ejecting the cassette is not allowed while priming, tuning, or testing.	The user attempts to eject the cassette while tests (priming/tuning/testing) are in progress.
1224	Advisory	Cleaning the cassette is not allowed while infusion, irrigation, or FAX is on.	The user attempts to start Cassette Cleaning when either Infusion, Irrigation or FAX is on.
1225	Advisory	Cleaning the cassette is not allowed without a functional cassette.	The user attempts to start Cassette Cleaning when the Cassette isn't available (e.g. not inserted).
1226	Advisory	Priming the cassette is not allowed without a functional cassette.	User attempt to prime the cassette when preconditions aren't met (e.g. no cassette inserted, cassette not tested or didn't pass the test).
1227	Advisory	An error occurred loading the device settings. The system will revert to default values.	A database attempt to load the device settings from the file system has failed. Reverting to defaults.
1228	Advisory	Command is not allowed while infusion is on.	The user tried to invoke a command which is only allowed when infusion is not on.
1229	Advisory	Command is not allowed while irrigation is on.	The user tried to invoke a command which is only allowed when irrigation is not on.
1230	Advisory	The selected step is not supported with the current cassette type.	The user attempts to select a Step whose mode/submode isn't compatible with the current operating mode.
1231	Advisory	The connected probe is not supported with the current cassette type.	The user connects a probe (with RFID) that's not compatible with the current operating mode (e.g. an Ultra Vit probe when an Anterior cassette is connected or Ultra Vit Anterior probe when a Posterior cassette is connected).

Error Code	Classification	Displayed Text	Discrepancy
1232	Advisory	Please connect footswitch.	The Supervisor has reported that no footswitch is connected.
1233	Advisory	The connected footswitch is not supported.	The Supervisor has detected the connection of an unknown footswitch.
1234	Advisory	Flow limit is currently not available due to flow mode being unavailabe.	Vacuum mode flow limit depends on the availability of flow mode. If flow mode becomes unavailable then the flow limit function can not be performed by the fluidics submodule.
1235	Advisory	IV Pole pressure mode is currently not available.	User attempts to select IV Pole as the infusion source but the IV Pole is not available (not configured, not working or Cassette is of Premium type)
1236	Advisory	Gravity pressure mode is currently not available.	User attempts to select Gravity as the infusion source when a Premium Cassette is inserted.
1237	Advisory	IOP Compensation is currently not available.	User attempts to turn IOP Compensation on when it's not available.
1238		An error occurred saving the device settings.	User attempt to save device settings fails.
1239	Advisory	Proportional reflux mode is currently not available.	User attempts to toggle into proportional reflux mode when the fluid level in the cassette chamber is out of range or the fluid level gets out of range while in proportional reflux.
1240	Advisory	Extraction flow mode is currently not available.	User attempts to toggle into flow mode when the fluid level in the cassette chamber is out of range or the fluid level gets out of range while in flow mode.
1241	Advisory	Infusion source is getting low: please check the bottle.	The infusion container fluid level is getting low.
1242	Advisory	Command is not allowed due to instrument not being available.	The user tried to invoke a command which is not allowed when no instrument is available for the command to work with.
1243	Advisory	Infusion / Irrigation source is empty: please press [Change] and replace the bottle.	The infusion fluid container is empty but there's still fluid in the cassette chambers.
1244	Advisory	Command is not allowed while priming, tuning, or testing.	The user attempts to do something, e.g. change Steps, that's not allowed when tests are in progress.
1245	Advisory	Please connect handpiece.	The user attempts to perform an action, e.g. priming, that requires a handpiece but no handpiece is connected. Note: This is only applicable to handpieces the system can detect connection for (e.g. Phaco)
1247	Advisory	Connected handpiece is not supported with the current cassette type.	User connects a handpiece that's not compatible with the current Cassette type. (e.g., a Frag handpiece is connected when an Anterior Cassette is inserted)
1248	Advisory	Is the inserted cassette new?	The user has inserted a Cassette which the system can't determine whether it's new or the same Cassette that was previously ejected.
1249	Advisory	An error occurred parsing the log file.	An error occurred parsing one of more lines of the log file.
1250	Advisory	Multi-Cut is not available when proportional scissors are selected. Press [Multi-Cut] to indicate that multi-cut scissors are currently connected.	The user has selected scissors of type Proportional and attempts to select the Multi-Cut submode or attempt to use momentary cutting in Extrusion Mode.
1251	Advisory	Command is not allowed while the cassette is being cleaned.	The user tried to turn Infusion, Irrigation or FAX on while the cassette is being cleaned.
1252	Advisory	The scanned barcode is not recognized.	The user has scanned an item that the system doesn't recognize.
1255	Advisory	Illuminator fiber is not connected.	User has attempted to turn on an illuminator with no illuminator fiber connected.
1256	Advisory	Proportional reflux mode is not available when the footswitch treadle is depressed.	User attempts to enter Proportional Reflux mode when the treadle is down
1257	Advisory	The report's header or footer has too many rows to fit on the page.	The user has added too many rows to a header or footer table being edited in an End Case report. As a result, the table will not be printed out in its entirety on the various pages comprising the report.

Error Code	Classification	Displayed Text	Discrepancy
1258	Advisory	The report's current table has too many rows to fit on the page.	The user has added too many rows to the current table being edited in an End Case report. As a result, the table will not be printed out in its entirety on the various pages comprising the report.
1259	Advisory	Command is not allowed while proportional diathermy is active.	The user attempts to enter proportional reflux while proportional diathermy is active.
1260	Advisory	Command is not allowed while proportional reflux is active.	The user attempts to enter proportional diathermy while proportional reflux is active.
1261	Advisory	Cassette can't be ejected while being cleaned.	The user attempts to eject the cassette while it's being cleaned.
1262	Advisory	Invalid handpiece tip.	The system attempts to select a tip that's not valid for the specific handpiece. This will only happen if an incorrect tip is specified for a scanned pak, i.e. the user will never be able to select an invalid tip from the UI.
1263	Advisory	Port can't be selected: there is no probe connected.	The user tries to make a laser port the active port but there's no probe connected to that port.
1264	Advisory	Port can't be selected: the probe type for the port isn't valid.	The user tries to make a laser port the active port but the currently selected probe type for that port is invalid.
1266	Advisory	A laser probe is not connected to the active port.	Shown in any of the following situations: • Laser Step entered and no probe connected to the active port • Probe removed from active port • User tries to go to Ready Mode when no probe is connected to the active port
1267	Advisory	A valid laser probe is not selected for the active port.	Shown in any of the following situations: • Laser Step entered and no valid probe type selected for the active port • User tries to go to Ready Mode when no valid probe type is selected for the active port

Error Code	Classification	Displayed Text	Discrepancy
1268	Advisory	The laser remote interlock is open.	Shown in any of the following situations: • Laser Step entered and the Interlock is open • Interlock opened in a Laser Step • User tries to go to Ready Mode when the Interlock is open
1269	Advisory	Laser Dr. Filters are not connected to the console. Are all necessary Dr. Filters properly installed and connected?	Shown in any of the following situations: • Laser Step entered and the Dr. Filters haven't been verified for the active port • Endo Probe inserted to the active port while in a Laser Step • User tries to go to Ready Mode when Dr. Filters haven't been verified for the active port.
1270	Advisory	One Laser Dr. Filter is connected to the console. Are all necessary Dr. Filters properly installed and connected?	Same as above
1271	Advisory	Two Laser Dr. Filters are connected to the console. Are all necessary Dr. Filters properly installed and connected?	Same as above
1273	Advisory	Laser Dr. Filter 1 is disengaged	The user has disengaged the (connected) Dr. Filter 1 while in a Laser Step.
1275	Advisory	Laser Dr. Filter 2 is disengaged	Same as 1273 but for Dr. Filter 2
1276	Advisory	Command is not allowed when Laser is firing.	User has attempted to change one of the laser's settings while the laser is firing.
1277	Advisory	Port can't be selected: it's not functional.	User has attempted to select a laser port that's not functional.
1278	Advisory	Cannot go to Laser Ready Mode while the current screen is being displayed.	User has pressed the Ready button from the footswitch when a "conflicting screen" is active.
1279	Advisory	No laser footswitch is connected.	User enters a Laser Step when no laser footswitch is connected or the laser footswitch is disconnected in a Laser Step.
1280	Advisory	Unable to write to the report file.	A problem has occurred when trying to write to the specified Report file.

Error Code	Classification	Displayed Text	Discrepancy
1281	Advisory	Unable to read from the report file.	A problem has occurred when trying to read from the specified Report file.
1285	Advisory	The report file and its associated CRC value do not match.	The Report file and its associated CRC value do not match.
1288	Advisory	Can't eject the cassette while reflux is active.	The user attempts to eject the cassette while reflux (of any type) is active. For proportional reflux, this advisory is displayed when the user attempts cassette ejection while proportional reflux mode is active with the treadle not depressed. Cassette ejection while the treadle is depressed will generate advisory 1220.
1289	Advisory	Extraction flow mode is not available when FAX is turned on.	FAX was turned on while in Flow Mode or a Posterior Step with Flow Mode preference was selected when FAX was on. The system then changed to Vacuum Mode.
1290	Advisory	The surgical function is currently unavailable.	The user has requested surgical functionality that is currently unavailable. This is a default advisory that is only displayed for cases in which a more meaningful explanation is not available.
1296	Advisory	The barcode reader failed to initialize.	The bar code reader failed to initialize during startup.
1297	Advisory	The system is currently low on free disk space. Please backup or remove non-critical files.	During startup, free space was detected at less than 15%.
1298	Advisory	A printer is not installed.	The user tried to print but no printer is installed.
1299	Advisory	The printer is out of paper.	The user sent a print job but the printer is out of, or ran out of paper.
1300	Advisory	The printer is off line.	The user requested a print job, but the printer is off line.
1302	Advisory	An unknown error occurred while printing.	Generated by any printer error other the errors above.
1303	Advisory	The Illuminators are currently turned off from the footswitch and cannot be turned on or off at this time.	The user has attempted to turn on or off an endo illuminator when the footswitch Momentary Endo Illuminators Off function is active.

Error Code	Classification	Displayed Text	Discrepancy
1304	Advisory	The Laser is currently unable to deliver the maximum power level of 2 Watts. The maximum Laser power (Watts) currently available is:	Is generated when the power available from the laser drops below the maximum level (2 Watts).
1305	Advisory	An error occurred loading a surgeon. The system will revert to default values.	A database attempt to load a surgeon from the file system has failed. Reverting to defaults.
1306	Advisory	An error occurred setting the printer port. The system will revert to the previous value.	Attempt to set the printer IP address failed.
1307	Advisory	An error occurred loading a procedure. The system will revert to default values.	A database attempt to load a procedure from the file system has failed. Reverting to defaults.
1308	Advisory	An error occurred loading the system settings. The system will revert to default values.	A database attempt to load the system settings from the file system has failed. Reverting to defaults.
1309	Advisory	An error occurred saving a surgeon's settings. Changes will be reverted at the start of the next case.	A database attempt to save a surgeon to the file system has failed.
1310	Advisory	An error occurred saving a procedure. Changes will be reverted at the start of the next case.	A database attempt to save a procedure from the file system has failed. Reverting to defaults.
1311	Advisory	An error occurred saving the system settings. The system will use default values.	A database attempt to save the system settings from the file system has failed. Reverting to defaults.
1312	Advisory	An error has occurred initializing Video Overlay. Video Overlay functions will be disabled.	An error happened during VideoOverlay initialization.
1313	Advisory	An error has occurred in the Video Overlay component. Video Overlay functions will be disabled.	An error happened during VideoOverlay processing.
1314	Advisory	There was an error saving surgeon data.	There was an error saving surgeon data.
1317	Advisory	There was an error renaming the surgeon.	There was an error renaming the surgeon.
1318	Advisory	There was an error renaming the procedure.	There was an error renaming the procedure.
1319	Advisory	There was an error renaming the case data.	There was an error renaming the case data.

Error Code	Classification	Displayed Text	Discrepancy
1320	Advisory	There was an error deleting the surgeon.	There was an error deleting the surgeon.
1321	Advisory	There was an error deleting the procedure.	There was an error deleting the procedure.
1322	Advisory	There was an error deleting the case data.	There was an error deleting the case data.
1323	Advisory	There was an error loading the surgeon.	There was an error loading the surgeon.
1324	Advisory	There was an error loading the procedure.	There was an error loading the procedure.
1325	Advisory	There was an error loading the case data.	There was an error loading the case data.
1326	Advisory	Unable to load the case report template.	There was an error loading the Case Report Template.
1329	Advisory	Unable to save the technician's log.	There was an error saving the Technician's Log.
1330	Advisory	Unable to load the video table.	There was an error loading the Video Table.
1331	Advisory	Unable to play the video.	There was an error loading and\ or playing the Video file.
1332	Advisory	Unable to load Help.	There was an error opening the Help pdf file.
1333	Advisory	Unable to save the case info.	There was an error saving the Case Info file.
1334	Advisory	Unable to update the log file.	There was an error writing to the Log File.
1335	Advisory	Unable to read the log file.	There was an error reading from the Log File.
1336	Advisory	Unable to write the incident file.	There was an error writing to the Incident File.
1337	Advisory	Unable to read the incident file.	There was an error reading from the Incident File.
1338	Advisory	Unable to write the system metrics file.	There was an error writing to the System Metrics File.
1339	Advisory	Unable to read the system metrics file.	There was an error reading from the System Metrics File.
1340	Advisory	Unable to write to the removable drive.	There was an error while attempting to write to the removable drive.

Error Code	Classification	Displayed Text	Discrepancy
1341	Advisory	Further increasing the output level in air can damage fiber tips. Would you like to continue?	The user has exceeded Threshold 1 (see SRS-5687.1) illuminator value by either turning on the illuminator, changing the setpoint while the illuminator is on, or changing Procedures while the illuminator is on.
1342	Advisory	Further increasing the output level will reduce exposure time by 35%. Would you like to continue?	The user has exceeded Threshold 2 (see SRS-5687.3) illuminator value by either turning on the illuminator, changing the setpoint, or changing Procedures.
1343	Advisory	Further increasing the output level in air can damage fiber tips. Also, further increasing the output level will reduce exposure time by 35%. Would you like to continue?	The user has exceeded both Threshold 1 and Threshold 2 (see SRS-5687.1 and SRS-5687.3) illuminator value by either turning on the illuminator, changing the setpoint while the illuminator is on, or changing Procedures while the illuminator is on.
1344	Advisory	Only two illuminators can be turned on simultaneously.	User attempts to turn on an illuminator port when two ports are already on. This is not allowed.
1345	Advisory	AGF not allowed while Forceps or VFC is in use.	User attempts to start Auto Gas Filling when either Forceps or VFC is in use (i.e. selected and treadle down).
1346	Advisory	An error occurred trying to access the wireless network.	An error occurs when the user attempts to access the wireless network.
1349	Advisory	A RAID hard drive has failed or is missing	One Disk in a redundant RAID volume is missing or has failed but the volume is still functional.
1350	Advisory	The probe in the current laser port is not supported.	The type of probe in the current port is not supported by NGVS but might be supported by NGL (slit lamp for example).
1355	Advisory	Command is not allowed when the Pneumatics submodule is not functional.	The user tried to invoke a command which is only allowed when the Pneumatics subsystem is functional.
1356	Advisory	Command is not allowed when an Anterior Only Cassette is being used.	The user tried to invoke a command which is not allowed with an Anterior Only Cassette.
1357	Advisory	Cannot switch to Infusion: the cassette has not been primed.	The user tried to switch to Infusion when the cassette was not primed.

Error Code	Classification	Displayed Text	Discrepancy
1358	Advisory	Current probe type is unrecognized. Please select a valid probe type.	User has attempted to turn on an illuminator when the probe type is “unrecognized”.
1359	Advisory	Power module communication error. When powering down the system, you will have to press the “Options/Shutdown” button on the screen.	Host controller failed to communicate with power module.
1361	Advisory	Command is not allowed when Infusion backup pressure is active.	The user tried to invoke a command which is only allowed when Infusion backup pressure is not active.
1362	Advisory	Command is not allowed when the probe type has been identified by RFID.	The user tried to change the type of a laser probe that has been identified by RFID.
1363	Advisory	Command is not allowed when the probe type has been previously identified by the user. Disconnect and then reconnect the probe to change its type.	The user tried to change the type of a laser probe that has been identified by a user selection. Only one selection is allowed after connection.
1364	Advisory	IOP Compensation is not allowed without a premium cassette inserted. Please insert a premium cassette and retry.	The user tried to turn on IOP compensation when a premium cassette is not inserted.
1365	Advisory	IOP Compensation is not allowed with an uncalibrated cassette. Please calibrate cassette and retry.	The user tried to turn on IOP compensation with a cassette that has not been calibrated.
1366	Advisory	Command is not allowed when FAX is on and the cassette has not been primed.	The user tried to perform a Test Instrument command when FAX is on and the cassette is not primed.
1367	Advisory	FAX is not allowed when the cassette is being primed.	The user tried to turn on FAX when the cassette is being primed.
1369	Advisory	Setting values is not allowed when the cassette is in the chamber overflow condition.	The cassette chamber is in an overflow condition and pressure cannot be controlled.
1370	Advisory	Test instrument is not allowed in this mode.	User has attempted to perform a test instrument command in Setup or End Case.
1751	Information	The remote control battery is low.	User has pressed on a remote control button and the remote’s battery is running out of power.
1752	Information	Infusion pressure will drop to zero during calibration. Continue?	User has pressed the “Calibrate” button on the advisory popup brought up when there’s been an IV Pole error. Since I/V Pole calibration will change the current Infusion pressure, the user is warned before calibration is started.
1753	Information	Power recovery is in progress. Please wait until surgical functions become available.	AC power has been restored and the recovery process has started.
2100	Fault	Fault - 2100 Call Field Service	A two second heart beat reply from the host was missed.
2200	Error	Communications failure with the Fluidics submodule. Fluidics functions will be disabled.	The supervisor cannot establish communicate with the Fluidics submodule.
2201	Error	Communications failure with the Fluidics submodule. Fluidics functions will be disabled.	The supervisor lost communicate with the Fluidics submodule
2202	Advisory	Unable to perform this function without a primed cassette.	This advisory is produced when extraction is attempted without a primed cassette.
2203	Advisory	Unable to aspirate. Please turn on infusion.	This advisory is produced when extraction is attempted without infusion on.
2204	Advisory	Unable to aspirate while infusion/irrigation is unavailable.	This advisory is produced when extraction is attempted without infusion being functional.
2205	Advisory	Please wait: draining cassette.	This advisory is produced when extraction is attempted when the extraction chamber is in a overflow condition.
2206	Advisory	Unable to turn on infusion without a primed cassette.	This advisory is produced when infusion is attempted with out a primed cassette.
2207	Advisory	Unable to turn on infusion without a calibrated IV pole.	This advisory is produced when infusion is attempted with out a calibrated IV Pole.
2208	Advisory	Unable to turn on infusion without sufficient source pressure.	This advisory is produced when infusion is attempted with out source air pressure
2209	Advisory	Unable to turn on irrigation without a primed cassette.	This advisory is produced when irrigation is attempted with out a primed cassette.
2210	Advisory	Unable to turn on infusion without a calibrated IV pole.	This advisory is produced when irrigation is attempted with out a calibrated IV Pole.

Error Code	Classification	Displayed Text	Discrepancy
2211	Advisory	Unable to turn on irrigation without sufficient source pressure.	This advisory is produced when irrigation is attempted with out suitable source pressure.
2212	Advisory	Irrigation unavailable: out of fluid. Please change the bottle.	This advisory is produced when irrigation is attempted with out sufficient irrigation fluid available
2213	Advisory	FAX unavailable. Please insert a cassette.	This advisory is produced when F/AX is attempted with out a cassette inserted.
2214	Error	Extraction setpoint timeout. Infusion/Irrigation and Extraction functions will be disabled.	This error is produced when the extraction is active and the extraction proxy fails to get a footswitch update within 20 msec
2215	Advisory	Micro reflux is currently not available.	This error is produced when the the user attempt to activate micro reflux and the fluid level is out of range.
2250	Error	Communications failure with the Pneumatics submodule. Pneumatics functions will be disabled.	The supervisor cannot communicate with the Pneumatics submodule.
2251	Error	Communications failure with the Pneumatics submodule. Pneumatics functions will be disabled.	This error is produced when the Supervisor losses communication with the pneumatics module.
2252	Advisory	Unable to turn on cutting without sufficient source pressure.	This advisory is produced when cutter or utility operation is requested with out sufficient source pressure.
2253	Advisory	Unable to turn on cutting with excessive source pressure.	This advisory is produced when cutter or utility operation is requested with source pressure that is too high.
2254	Error	Pneumatics setpoint timeout. Pneumatics functions will be disabled.	This error is produced when the pneumatics is active and the pneumatics proxy fails to get a footswitch update within 20 msec.
2300	Error	Communications failure with the Ultrasound submodule. Ultrasound functions will be disabled.	The supervisor cannot communicate with the Ultrasound submodule.
2301	Error	Communications failure with the Ultrasound submodule. Ultrasound functions will be disabled.	The supervisor lost communication with the Ultrasound submodule.
2302	Error	US setpoint timeout. US and Diathermy functions will be disabled.	This error is produced when the US is active and the US proxy fails to get a footswitch update within 20 msec.
2350	Error	Communications failure with the Laser submodule. Laser functions will be disabled.	The supervisor cannot communicate with the Laser submodule.
2351	Advisory	Communications failure with the Laser submodule. Laser functions will be disabled.	The supervisor lost communication with the Laser submodule.
2400	Advisory	Please insert the Table Top Illuminator drawer.	Supervisor detected a non –zero setpoint with the Table Top Illuminator drawer out.
2401	Advisory	The lamp in the Table Top Illuminator needs to be replaced. Please contact Field Service.	Supervisor detected a non–zero setpoint with the Table Top Illuminator Lamp bad.
2500	Advisory	Communications failure with the Power Control submodule. Please contact Field Service.	Supervisor detected a serial I/O error when trying to talk to the Power Module.
2550	Error	Footswitch error. Footswitch treadle functions will be disabled.	The footswitch has an error.
2600	Advisory	IV Pole over-current error. IV Pole functions will be disabled.	IV Pole motor is drawing too much current.
2700	Error	Communications failure with the Auxiliary Illuminator submodule. Auxiliary Illuminator functions will be disabled.	The supervisor cannot communicate with the Auxiliary Illuminator submodule.
2701	Advisory	Communications failure with the Auxiliary Illuminator submodule. Auxiliary Illuminator functions will be disabled.	The supervisor lost communication with the Auxiliary Illuminator submodule.
2702	Advisory	The lamp in the Auxiliary Illuminator needs to be replaced. Please contact Field Service.	- Supervisor detected a non–zero setpoint with the Auxiliary Illuminator Lamp bad.
2750	Fault	Fault - 2750 Call Field Service	The Supervisor could not assert reset control over all submodules. A module that was supposed to be reset responded with its module information.
2751	Fault	Fault - 2751 Call Field Service	The Supervisor got duplicate slot ID for the submodules.

Error Code	Classification	Displayed Text	Discrepancy
3100	Advisory	Could not calibrate the fluid level sensors. Please eject and reinsert, or replace the cassette.	Level Sensor calibration failed. The calibration done status bit was not set by the FPGA within the specified timeout limit or the calculated required max/min pixel gain was outside the valid range.
3200	Error	Cassette latch error. Please remove and reinsert the cassette.	Cassette latch hardware feedback signals indicate a hardware problem.
3201	Advisory	Invalid cassette ID detected. Please eject and insert a valid cassette.	An invalid cassette id was read by the cassette id sensors.
3202	Advisory	Cassette test failed. Please eject and reinsert, or replace cassette.	Cassette pressure and/or vaccum tests failed.
3203	Advisory	The cassette was not properly latched into position. Please remove and reinsert the cassette.	The cassette latch optical position sensor indicates that the latch did not reach its locked position.
3204	Error	Cassette ID sensor error. Infusion/irrigation and extraction functions will be disabled.	Cassette ID sensor test failed. The sensor output voltage is not within the expected range.
3205	Advisory	The Fluidics module fan is not working.	The Fluidics module fan tachometer indicates that the Fluidics module fan is not operating.
3300	Advisory	Draining cassette. Please wait.	The cassette aspiration chamber is full of fluid.
3302	Advisory	N/A	Not enough or too much fluid in the aspiration chamber to allow aspiration flow mode and reflux. NOTE: This advisory is never explicitly displayed. Instead advisory 1239 or 1240 might be displayed if appropriate. See 11239 and 11240 for details.
3304	Advisory	Leak test failure. Please confirm the irrigation tubing; aspiration tubing , and the test chamber are properly connected to the handpiece.	A leak in the aspiration or irrigation tubing was detected during flow check of a handpiece.
3305	Advisory	Priming of the aspiration probe was unsuccessful. Please attempt to re-prime the probe.	Probe prime was unsuccessful. The required volume of fluid was not transferred through the aspiration tubing set within the specified timeout period.
3306	Advisory	Priming of the aspiration handpiece was unsuccessful. Please attempt to re-prime the handpiece.	Handpiece prime was unsuccessful. The required volume of fluid was not transferred through the aspiration tubing set within the specified timeout period.
3307	Error	Aspiration level sensor problem detected. Infusion/irrigation and extraction functions will be disabled.	The level sensor status signals indicate a level sensor hardware problem.
3308	Advisory	Flow check failure: measured flow restriction is too high. Extraction and Ultrasound functions in Phaco/Frag will be disabled.	The handpiece failed the flow-check. Too high vacuum level was required to achieve the reference flow level.
3309	Advisory	Flow check failure: aspiration chamber could not be filled with fluid. Extraction and Ultrasound functions in Phaco/Frag will be disabled.	The handpiece failed the flow-check. Too high vacuum level was required to achieve the reference flow level.
3325	Advisory	Drain bag is almost full. Please replace bag and press [Done].	~50 cc remaining volume in drain bag.
3326	Advisory	Drain bag is full. Please replace bag and press [Done].	~0 cc remaining volume in drain bag.
3327	Advisory	Drain bag is critically full. Please replace bag and press [Done].	Drain bag filled > 50 cc above capacity.
3329	Error	Drain pump problem detected. Infusion/irrigation and extraction functions will be disabled.	The commanded pump rate does not correspond to the actual pump rate measured by the optical encoder.
3330	Advisory	The drain pump fan is not working.	The drain pump fan tachometer indicates that the drain pump fan is not operating.
3331	Advisory	Could not drain the aspiration chamber. Please remove and insert a new cassette.	The aspiration chamber could not be drained within the specified timeout period.
3350	Error	Extraction pressure transducer offset error. Infusion/irrigation and extraction functions will be disabled.	Extraction pressure transducer 0 offset out of range.
3351	Error	Extraction pressure transducer discrepancy error. Infusion/irrigation and extraction functions will be disabled.	A discrepancy between the primary and redundant extraction pressure transducers was detected.
3352	Error	Extraction isolation valve error. Infusion/irrigation and extraction functions will be disabled.	Extraction isolation valve hardware error.

Error Code	Classification	Displayed Text	Discrepancy
3353	Error	Reflux valve error. Infusion/irrigation and extraction functions will be disabled.	Extraction reflux valve hardware error.
3354	Error	Extraction output valve (S1) error. Infusion/irrigation and extraction functions will be disabled.	Extraction output pincher valve (S1) error
3355	Error	Extraction output valve (S11) error. Infusion/irrigation and extraction functions will be disabled.	Extraction output port 1 pincher valve error.
3356	Error	Extraction output valve (S22) error. Infusion/irrigation and extraction functions will be disabled.	Extraction output port 2 pincher valve error.
3357	Error	Extraction cross-connection valve (SC) error. Infusion/irrigation and extraction functions will be disabled.	Extraction “normally open” cross-connection valve error.
3358	Error	Extraction cross-connection valve (SC2) error. Infusion/irrigation and extraction functions will be disabled.	Extraction “normally closed” cross-connection valve error.
3359	Advisory	Suction pressure surges detected. Vacuum will be disabled. Please release the footswitch treadle to reset.	Extraction pressure oscillations detected.
3360	Advisory	Suction flow surges detected. Flow will be disabled. Please release the footswitch treadle to reset.	Extraction flow oscillations detected.
3361	Advisory	Suction pressure is too high. Vacuum will be disabled. Please release the footswitch treadle to reset.	Extraction pressure overshoot detected.
3362	Advisory	Aspiration flow too high. Flow will be disabled. Please release the footswitch treadle to reset.	Extraction flow overshoot detected.
3363	Error	Extraction pressure transducer reference voltage out of range. Infusion/irrigation and extraction functions will be disabled.	Extraction transducer reference voltage error.
3400	Error	Infusion source container pressure transducer offset error. Infusion/irrigation and extraction functions will be disabled.	Infusion source container pressure transducer 0 offset out of range.
3401	Error	Infusion source container isolation valve error. Infusion/irrigation and extraction functions will be disabled.	Infusion source container isolation valve error.
3402	Error	Infusion source container transducer discrepancy error. Infusion/irrigation and extraction functions will be disabled.	A dispcrepancy between the source container and LPAS pressure transducers was detected.
3403	Error	Infusion source container pressure too high. Infusion/irrigation and extraction functions will be disabled.	Infusion source container pressure too high.
3420	Error	Infusion pressure transducer offset error. Infusion/irrigation and extraction functions will be disabled.	Infusion pressure transducer 0 offset out of range
3421	Error	Infusion pressure transducer discrepancy error. Infusion/irrigation and extraction functions will be disabled.	A dispcrepancy between the primary and redundant infusion pressure transducers was detected.
3422	Error	Infusion isolation valve error. Infusion/irrigation and extraction functions will be disabled.	Infusion isolation valve error.
3423	Error	Infusion FAX valve error. Infusion/irrigation and extraction functions will be disabled.	Infusion FAX valve error.
3424	Error	Infusion input valve error. Infusion/irrigation and extraction functions will be disabled.	Infusion chamber input pincher valve error.
3425	Error	Infusion output valve error. Infusion/irrigation and extraction functions will be disabled.	Infusion chamber output pincher valve error.
3426	Error	Irrigation output valve error. Infusion/irrigation and extraction functions will be disabled.	Irrigation output pincher valve error.
3427	Error	Infusion pressure surges detected. Infusion/irrigation and extraction functions will be disabled.	Infusion pressure oscillations detected.
3428	Error	Infusion pressure too high. Infusion/irrigation and extraction functions will be disabled.	Infusion high pressure detected.
3429	Advisory	Low infusion pressure detected. Please check infusion connections. Select 30 mmHg backup pressure, or ignore low pressure condition.	Infusion pressure too low.

Error Code	Classification	Displayed Text	Discrepancy
3431	Advisory	Low irrigation pressure detected. Please check irrigation connections.	Irrigation pressure too low.
3433	Error	Infusion chamber isolation valve error. Infusion/irrigation and extraction functions will be disabled.	Infusion chamber isolation valve detected to be stuck closed during power up diagnostics.
3434	Advisory	Infusion chamber overflow error. Control of infusion pressure has possibly been lost. The current pressure, in mmHg, could be as high as:	Infusion chamber overflow error. The fluid level in the infusion chamber reached above the overflow level.
3436	Error	FAX valve error. Infusion/irrigation and extraction functions will be disabled.	F/AX valve detected to be stuck closed during power up diagnostics.
3437	Error	Iinfusion level sensor error. Infusion/irrigation and extraction functions will be disabled.	The level sensor status signals indicate a level sensor hardware problem.
3438	Advisory	No more infusion fluid available. Press [Change] to change the infusion bottle.	The infusion chamber in the cassette is empty.
3440	Advisory	No more irrigation fluid available. Press [Change] to change the infusion/irrigation bottle.	The irrigation chamber in the cassette is empty.
3442	Advisory	Irrigation chamber overflow detected. Control of irrigation pressure has possibly been lost. The current pressure, in mmHg, could be as high as:	Irrigation chamber overflow error. The fluid level in the irrigation chamber reached above the overflow level.
3460	Error	Infusion backup valve error. Infusion/irrigation, extraction, and Ultrasound functions will be disabled.	Infusion backup valve error.
3461	Error	Infusion LPAS pump error detected. Infusion/irrigation, extraction, and Ultrasound functions will be disabled.	The infusion LPAS pump tachometer indicate that the LPAS pump is not operating correctly.
3462	Advisory	Infusion flow sensor communication error. IOP Compensation functions will be disabled.	Infusion flow sensor communication error.
3464	Advisory	Infusion flow data invalid: IOP Compensation functions will be disabled. Check infusion tubing for air bubbles.	Infusion flow sensor readings are not valid.
3466	Advisory	Infusion flow sensor accuracy error. IOP Compensation functions will be disabled.	Infusion flow sensor accuracy error. Flow sensor and chamber fluid volume measurements are out of range of each other. Detected during flow sensor calibration.
3467	Advisory	Infusion flow sensor signal amplitude is low. IOP Compensation functions will be disabled. Please eject and reinsert the cassette.	Infusion flow sensor signal amplitude error. Detected during flow sensor calibration
3469	Advisory	Tubing calibration offset error. IOP Compensation functions will be disabled. Please position the infusion cannula at the height of the center of the cassette and re-prime.	Infusion tubing calibration 0 offset advisory. The infusion cannula was not positioned within the correct vertical range of the cassette during calibration.
3470	Advisory	Calibration verification error: calculated pressures using the acquired calibration profile are not within the expected range for the selected infusion cannula. IOP Compensation functions will be disabled. Please re-prime.	Infusion tubing calibration check point advisory. The pressure drop calculated using the acquired calibration profile was not within the expected range.
3471	Advisory	Noisy calibration flow readings. IOP Compensation functions will be disabled. Please re-prime.	Infusion tubing calibration standard deviation advisory. The standard deviation between the acquired flow measurements and the calculated calibration profile was larger than the specified max limit.
3472	Advisory	Infusion chamber leak detected. Please eject and replace the cassette.	A leak in the infusion chambers was detected during priming.
3473	Error	Infusion pressure transducer reference voltage out of range. Infusion/irrigation and extraction functions will be disabled.	Infusion transducer reference voltage error.
3474	Error	Infusion NIFS valve error detected. Infusion/irrigation and extraction functions will be disabled.	Infusion NIFS valve error.
3475	Advisory	Infusion prime failed.	Infusion prime failed.
3476	Advisory	The infusion chambers did not fill with fluid. Please check the infusion bottle and connections or press [Change] to replace the infusion bottle.	Infusion chamber did not fill within the specified timeout period. Source container is out of fluid.

Error Code	Classification	Displayed Text	Discrepancy
3477	Error	Infusion LPAS pressure transducer offset error. Infusion/irrigation and extraction functions will be disabled.	Infusion LPAS pressure transducer 0 offset out of range.
3478	Error	Infusion LPAS pressure error. Infusion/irrigation and extraction functions will be disabled.	Infusion LPAS source pressure too high.
3479	Advisory	Infusion LPAS pressure is low. Infusion pressure loss is possible.	Infusion LPAS pump output pressure is low.
3481	Advisory	Infusion flow sensor is disconnected. IOP Compensation functions will be disabled.	Infusion flow sensor is disconnected or the sensor connection has failed.
4100	Error	U/S voltage failure (+5 analog). Ultrasound and Diathermy functions will be disabled.	US Kernel Analog 5 volt feedback is bad. US Submodule is non-functional.
4101	Error	U/S voltage failure (+2.5). Ultrasound and Diathermy functions will be disabled.	US Kernel +2.5 volt feedback is bad. US submodule is non-functional.
4102	Error	U/S voltage failure (-2.5). Ultrasound and Diathermy functions will be disabled.	US Kernel -2.5 volt feedback is bad. US submodule is non-functional.
4103	Error	U/S voltage failure (+8.5). Ultrasound and Diathermy functions will be disabled.	US Kernel 2.5 volt feedback is bad. US submodule is non-functional.
4111	Error	US failure: SPI driver write timeout. Ultrasound and Diathermy functions will be disabled.	SPI driver timed out waiting for a write to complete. US submodule is non-functional.
4200	Advisory	Handpiece EEPROM CRC is invalid. Please replace the handpiece.	The handpiece EEPROM CRC is invalid. Handpiece needs to be replaced.
4201	Advisory	Only one US handpiece may be connected at a time. Please remove one of the handpieces.	Two US handpieces are connected. One of the handpieces must be removed before the other handpiece can be used.
4202	Advisory	Handpiece current is too low. Please replace handpiece and re-tune.	U/S handpiece current is too low. A short circuit in the handpiece can cause this.
4203	Advisory	Handpiece voltage is too low. Please replace handpiece and re-tune.	U/S handpiece voltage is too low. An open circuit in the handpiece can cause this.
4204	Advisory	Handpiece power is too high. Please replace handpiece and re-tune.	U/S handpiece power output is too high.
4206	Advisory	Handpiece power DC2DC output was out of range. Please release the footswitch treadle to reset. If problem persists, please contact Field Services.	While powering the handpiece, the DC2DC voltage for handpiece power is out of range.
4207	Advisory	Handpiece was removed while powered. Please reconnect handpiece and re-tune.	User has disconnected the handpiece while it's being powered.
4208	Advisory	Data in handpiece EEPROM is out of range. Please replace the handpiece.	Data contained in the handpiece is out of range.
4209	Advisory	Unknown US handpiece connected. Please connect a known handpiece.	The system has detected that a US handpiece was connected but it cannot determine its type.
4210	Advisory	Unsupported US handpiece connected. Please connect a supported handpiece.	The system has detected the connection of a recognized US handpiece but that handpiece is not supported by this system. Handpiece is not tuned.
4220	Advisory	Tune failure – attempted while handpiece was in air. Please re-tune the handpiece.	The handpiece was tuned while in air. Handpiece is not tuned.
4221	Advisory	Tune failure: handpiece was removed before tuning. Please connect a handpiece and re-tune.	A handpiece tune was requested but no handpiece is connected.
4222	Advisory	Tune failure: handpiece is an unknown type. Please connect a known handpiece and re-tune.	A handpiece tune was requested but an unknown type of handpiece is connected.
4223	Advisory	Tune failure: handpiece has a loose tip. Please tighten the tip and re-tune.	The handpiece tip was loose when tuned. Handpiece is not tuned.
4224	Advisory	Tune failure: handpiece current is low. Please replace handpiece and re-tune.	The handpiece current was too low (open circuit). Handpiece is not tuned.
4225	Advisory	Tune failure: handpiece voltage is low. Please replace handpiece and re-tune.	The handpiece voltage was too low when tuned (short circuit). Handpiece is not tuned.
4226	Advisory	Tune failure: handpiece frequency order error. Please re-tune.	The series (low impedance) and parallel (high impedance) frequencies were out of order when the handpiece was tuned.
4228	Advisory	Tune failure: handpiece series frequency margin error. Please re-tune.	The series tune frequency was too close to the tune start frequency while tuning the handpiece. The handpiece is not tuned.

Error Code	Classification	Displayed Text	Discrepancy
4229	Advisory	Tune failure: handpiece parallel frequency margin error. Please re-tune.	The parallel tune frequency was too close to the tune end frequency while tuning the handpiece. The handpiece is not tuned.
4231	Advisory	Tune failure: handpiece frequency bandwidth too low. Please re-tune.	The difference between the series and parallel tune frequencies was too small while tuning the handpiece. The handpiece is not tuned.
4232	Advisory	Tune failure: handpiece frequency bandwidth too high. Please re-tune	The difference between the series and parallel tune frequencies was too large while tuning the handpiece. The handpiece is not tuned.
4234	Advisory	Tune failure: handpiece DC2DC output out of range. Please re-tune. If problem persists, please contact Field Service.	The DC2DC voltage was out of range while tuning the handpiece. The handpiece is not tuned.
4235	Advisory	Tune failure: handpiece removed while tuning. Please connect handpiece and re-tune.	The handpiece was removed while tuning. The handpiece is not tuned.
4240	Advisory	The requested Frag continuous power is too high. The Power level will be limited.	A request for more than 60% frag power was made while not in a pulsed mode. The power will be limited to 60%.
4250	Error	Ultrasound failure: ADC calibration. Ultrasound functions will be disabled.	The ADC feedback reading with power off for DC2DC voltage, handpiece voltage, or handpiece current was too high.
4300	Error	Diathermy failure: DC2DC output was out of range. Diathermy functions will be disabled.	While powering the handpiece, the DC2DC voltage for handpiece power is out of range.
4301	Advisory	Diathermy power is too high. Please release the footswitch treadle / button and try again.	Too much power was being delivered to the diathermy handpiece. Diathermy power is turned off. The operator must release the treadle/switch and the depress the treadle/switch to re-activate power.
5100	Error	Ballast failure (voltage). Illuminator functions will be disabled.	Ballast transducer has reading that is out of specified safety range.
5101	Error	Ballast failure (current). Illuminator functions will be disabled.	Ballast transducer has reading that is out of specified safety range.

Error Code	Classification	Displayed Text	Discrepancy
5102	Advisory	Lamp calibration data is corrupted: lamp needs to be calibrated. Please contact Field Service.	The calibration data saved in the flash contains incorrect CRC checksum.
5103	Advisory	Failure to turn lamp on: lamp needs to be replaced. Please contact Field Service.	Lamp status reported by hardware is not the same as software status.
5104	Advisory	The lamp has exceeded its rated life. Please replace the lamp.	The lamp has exceeded its rated life. The new lamp is expected.
5105	Advisory	The lamp has exceeded its rated maximum life. Please install a new lamp immediately.	The lamp has exceeded its rated safe life. The new lamp should be installed immediately.
5107	Advisory	The Table-Top Illuminator drawer is ejected. Please close the drawer to continue.	The module has been pulled out of drawer.
5109	Information	The calibration data for the Illuminator has changed: due to recalibration or replacement with a new unit.	The calibration data is changed.
5200	Advisory	Illuminator optics temperature is high. The lamp will be turned off if the temperature continues to rise.	Optics temperature is too high. Lamp is going to be shut down if temperature continues to rise.
5201	Error	Illuminator optics temperature has exceeded its limit. Illuminator functions will be disabled.	Illuminator is shut down because Optics temperature is too high.
5202	Advisory	Illuminator optics fan is at full speed. Optics unit may be overheating.	Warning that the Optics fan is full on.
5203	Error	Illuminator optics thermo-cut-off has been triggered. Illuminator functions will be disabled.	Lamp is turned off because thermo cut-off.
5204	Advisory	Communication failure with the Illuminator optics fan. The fan may not work properly.	Communication Error with optics fan.
5300	Advisory	Illuminator ballast temperature is high. The lamp will be turned off if the temperature continues to rise.	Ballast temperature is too high. Lamp is going to be shut down if temperature continues to rise.
5301	Error	Illuminator ballast temperature has exceeded its limit. Illuminator functions will be disabled.	Illuminator is shut down because Ballast temperature is too high.
5302	Advisory	Illuminator ballast fan is at full speed. Ballast unit may be overheating.	Warning that the Ballast fan is full on.

Error Code	Classification	Displayed Text	Discrepancy
5303	Error	Illuminator ballast thermo-cut-off has been triggered. Illuminator functions will be disabled.	Lamp is turned off because thermo cut-off.
5304	Advisory	Communication failure with the Illuminator ballast fan. The fan may not work properly.	Communication Error with ballast fan.
5400	Error	Lamp louver failure at port 1: unable to move to home position. Port 1 will be disabled.	Step motor at port 1 failed to move to home position.
5401	Error	Lamp Louver failure at port 2: unable to move to home position. Port 2 will be disabled.	Step motor at port 2 failed to move to home position.
5402	Error	Lamp Louver failure at port 1: unable to move to specified position. Port 1 will be disabled.	Step motor at port 1 failed to move to specified position.
5403	Error	Lamp Louver failure at port 2: unable to move to specified position. Port 2 will be disabled.	Step motor at port 2 failed to move to specified position.
6101	Error	Pressure reading is too high. Cutting and Pneumatics functions will be disabled.	Pneumatics pressure is too high.
6201	Error	Air Pressure valves have high transition faults. Cutting and Pneumatics functions will be disabled.	AirPressure valves have high level faults (fail to open).
6202	Error	Air Pressure valves have low transition faults. Cutting and Pneumatics functionals will be disabled.	AirPressure valves have low level faults (fail to close).
6203	Advisory	Air Pressure inlet filter may be dirty and needs to be replaced. Please contact Field Service.	The unusual high pressure drop cross the Air Filter. This is caused by either the Air Filter is too dirty and need to be replaced or the system may be leaking air.
6204	Advisory	Inlet pressure is too low for the system. Please adjust the inlet pressure to higher than 58 psi.	The Air source (wall pressure) is too low (below 58 psi) to turn on. On startup, Pneumatics turns on the pressure automatically if the pressure is high enough (above 58 psi).
6206	Advisory	Inlet pressure is too high for the system. Please adjust the inlet pressure to less than 140 psi.	The Air source (wall pressure) is too high (above 120 psi) to turn on. On startup, Pneumatics turns on the pressure automatically if the pressure is high enough (above 58 psi).
6208	Error	Inlet pressure is unstable. Pneumatics functions will be disabled. Please restart the system.	The Air source pressure (wall pressure) is unstable to cause the system unexpected to turn On/Off pressure.
6301	Error	Cutting errors; valves have high transition faults (failed to open). Cutting functions will be disabled.	Cutters valves have high level faults (fail to open).
6302	Error	Cutting errors; valves have low transition faults (failed to close). Cutting functions will be disabled.	Cutters valves have low level faults (fail to close).
6303	Error	Cutting error: redundant transducers discrepancy error. Cutting functions will be disabled. Please contact Field Service.	Cutters redundant transducers discrepancy error.
6304	Error	Cutting error: redundant transducers calibration. Cutting functions will be disabled. Please contact Field Service.	Cutters redundant transducers calibration error.
6305	Advisory	Cutting pressure is oscillating beyond the specified range. Please release the footswitch treadle to reset.	Cutters actual pressure is oscillating beyond the specified tolerance.
6306	Advisory	Cutting pressure is surging beyond the specified tolerance. Please release the footswitch treadle to reset.	Cutters actual pressure is surging beyond the specified tolerance.
6401	Error	Utilities valves have high transition faults (failed to open). Pneumatics functions will be disabled.	Utilities valves have high level faults (fail to open).
6402	Error	Utilities valves have low transition faults (failed to close). Pneumatics functions will be disabled.	Utilities valves have low level faults (fail to close).
6403	Error	Utilities redundant transducers discrepancy error. Pneumatics functions will be disabled. Please contact Field Service.	Utilities redundant transducers discrepancy error.
6404	Error	Utilities redundant transducers calibration error. Pneumatics functions will be disabled. Please contact Field Service.	Utilities redundant transducers calibration error.
6405	Error	Vacuum redundant transducers discrepancy error. Pneumatics functions will be disabled. Please contact Field Service.	Vacuum redundant transducers discrepancy error.

Error Code	Classification	Displayed Text	Discrepancy
6406	Error	Vacuum redundant transducers calibration error. Pneumatics functions will be disabled. Please contact Field Service.	Vacuum redundant transducers calibration error.
6407	Advisory	Utilities pressure is oscillating beyond the specified range. Please release the footswitch treadle to reset.	Utilities actual pressure is oscillating beyond the specified tolerance.
6408	Advisory	Utilities pressure is surging beyond the specified tolerance. Please release the footswitch treadle to reset.	Utilities actual pressure is surging beyond the specified tolerance.
6501	Error	Auto Gas valves have high transition faults (failed to open). Pneumatics functions will be disabled.	Auto Gas valves have high level faults (fail to open).
6502	Error	Auto Gas valves have low transition faults (failed to close). Pneumatics functions will be disabled.	Auto Gas valves have low level faults (fail to close).
6503	Error	Auto Gas redundant transducers discrepancy error. Pneumatics functions will be disabled. Please contact Field Service.	Auto Gas redundant transducers discrepancy error.
6504	Error	Auto Gas redundant transducers calibration error. Pneumatics functions will be disabled. Please contact Field Service.	Auto Gas redundant transducers calibration error.
6505	Advisory	C3F8 bottle may be empty and needs to be replaced. Please press [Replaced] to confirm bottle replacement.	Gas 1 bottle may be empty and needs to be filled up.
6506	Advisory	SF6 bottle may be empty and needs to be replaced. Please press [Replaced] to confirm bottle replacement.	Gas 2 bottle may be empty and needs to be filled up.
7100	Error	Ballast failure (voltage). Illuminator functions will be disabled.	Ballast transducer has reading that is out of specified safety range.
7101	Error	Ballast failure (current). Illuminator functions will be disabled.	Ballast transducer has reading that is out of specified safety range.
7102	Advisory	Lamp calibration data is corrupted: lamp needs to be calibrated. Please contact Field Service	The calibration data saved in the flash contains incorrect CRC checksum.
7103	Advisory	Failure to turn lamp on: lamp needs to be replaced. Please contact Field Service.	Lamp status reported by hardware is not the same as software status.
7104	Advisory	The lamp has exceeded its rated life: lamp needs to be replaced. Please contact Field Service.	The lamp has exceeded its rated life. The new lamp is expected.
7105	Advisory	The lamp has exceeded its rated maximum life: lamp needs to be replaced. Please contact Field Service.	The lamp has exceeded its rated safe life. The new lamp should be installed immediately.
7200	Advisory	Illuminator optics temperature is high. The lamp will be turned off if the temperature continues to rise.	Optics temperature is too high. Lamp is going to be shut down if temperature continues to rise.
7201	Error	Illuminator optics temperature has exceeded its limit. Illuminator functions will be disabled.	Illuminator is shut down because Optics temperature is too high.
7202	Advisory	Illuminator optics fan is at full speed. Optics unit may be overheating.	Warning that the Optics fan is full on.
7203	Error	Illuminator optics thermo-cut-off has been triggered. Illuminator functions will be disabled.	Lamp is turned off because thermo cut-off.
7204	Advisory	Communication failure with the Illuminator optics fan. The fan may not work properly.	Communication Error with optics fan.
7300	Advisory	Illuminator ballast temperature is high. The lamp will be turned off if the temperature continues to rise.	Ballast temperature is too high. Lamp is going to be shut down if temperature continues to rise.
7301	Error	Illuminator ballast temperature has exceeded its limit. Illuminator functions will be disabled.	Illuminator is shut down because Ballast temperature is too high.
7302	Advisory	Illuminator ballast fan is at full speed. Ballast unit may be overheating.	Warning that the Ballast fan is full on.
7303	Error	Illuminator ballast thermo-cut-off has been triggered. Illuminator functions will be disabled.	Lamp is turned off because thermo cut-off.
7304	Advisory	Communication failure with the Illuminator ballast fan. The fan may not work properly.	Communication Error with ballast fan.

Error Code	Classification	Displayed Text	Discrepancy
7400	Error	Lamp louver failure at port 3: unable to move to home position. Port 3 will be disabled.	Step motor at port 1 failed to move to home position.
7401	Error	Lamp louver failure at port 4: unable to move to home position. Port 4 will be disabled.	Step motor at port 2 failed to move to home position.
7402	Error	Lamp louver failure at port 3: unable to move to specified position. Port 3 will be disabled.	Step motor at port 1 failed to move to specified position.
7403	Error	Lamp louver failure at port 4: unable to move to specified position. Port 4 will be disabled.	Step motor at port 2 failed to move to specified position.
8100	Error	Laser controller software error. Laser functions will be disabled.	Need description.
8101	Error	Laser controller shutter open for too long error. Laser functions will be disabled.	Need description.
8102	Error	Laser controller shutter unexpected error. Laser functions will be disabled.	Need description.
8103	Error	Laser controller shutter open between firing error. Laser functions will be disabled.	Need description.
8104	Error	Laser controller mirror incorrect position error. Laser functions will be disabled.	Need description.
8105	Error	Laser controller mirror position unexpected error. Laser functions will be disabled.	Need description.
8106	Error	Laser controller power over the limit error. Laser functions will be disabled.	Need description.
8107	Advisory	Laser controller maximum current exceeded error. Laser functions will be disabled.	Need description.
8108	Error	Laser controller port power detection error. Laser functions will be disabled.	Need description.
8109	Error	Laser controller power detected at wrong port error. Laser functions will be disabled.	Need description.
8110	Error	Laser controller power reading mismatch error. Laser functions will be disabled.	Need description.

Error Code	Classification	Displayed Text	Discrepancy
8111	Error	Laser controller LBO crystal limit error. Laser functions will be disabled.	Need description.
8112	Error	Laser controller pump temperature limit error. Laser functions will be disabled.	Need description.
8113	Error	Laser controller power detect digital I/O mismatch error. Laser functions will be disabled.	Need description.
8114	Error	Laser controller footswitch digital I/O mismatch error. Laser functions will be disabled.	Need description.
8115	Error	Laser controller footswitch no NC (normally closed) error. Laser functions will be disabled.	Need description.
8117	Advisory	Laser controller internal parameter error.	Need description.
8118	Error	Laser controller process hunt error. Laser functions will be disabled.	Need description.
8119	Error	Laser controller process attach error. Laser functions will be disabled.	Need description.
8120	Error	Laser controller start up time out error. Laser functions will be disabled.	Need description.
8121	Error	Laser controller JEM CRC error. Laser functions will be disabled.	Need description.
8122	Error	Laser controller kernel CRC error. Laser functions will be disabled.	Need description.
8123	Error	Laser controller flash file error. Laser functions will be disabled.	Need description.
8124	Advisory	Laser LBO diode over temperature error.	Need description.
8125	Advisory	Laser LBO diode under temperature error.	Need description.
8126	Advisory	Laser controller crystal overtemperature error.	Need description.
8127	Advisory	Laser controller crystal undertemperature error.	Need description.
8129	Advisory	Laser controller probe connection error.	Need Description

Error Code	Classification	Displayed Text	Discrepancy
8131	Error	Laser controller power monitor POST error. Laser functions will be disabled.	Need description.
8132	Error	Laser controller +2.5 volt out-of-range error. Laser functions will be disabled.	Need description.
8134	Error	Laser controller 12 volt power error. Laser functions will be disabled.	Need description.
8135	Error	Laser shutter timer expired error. Laser functions will be disabled.	Need description.
8138	Error	Laser controller diode thermal electric cooler error. Laser functions will be disabled.	Need description.
8139	Error	Laser probe port process POST error. Laser functions will be disabled.	Need description.
8140	Error	Laser controller startup time-out error (laser engine). Laser functions will be disabled.	Need description.
8141	Error	Laser controller startup timeout error (shutter control process). Laser functions will be disabled.	Need description.
8142	Error	Laser controller startup timeout error (supervisor process). Laser functions will be disabled.	Need description.
8143	Error	Laser controller startup timeout error (peripheral management process). Laser functions will be disabled.	Need description.
8144	Error	Laser controller startup timeout error (probe port process). Laser functions will be disabled.	Need description.
8145	Error	Laser controller startup timeout error (laser system controller). Laser functions will be disabled.	Need description.
8147	Error	Laser controller TMP crystal startup timeout error. Laser functions will be disabled.	Need description.
8148	Error	Laser controller TMP diode startup timeout error. Laser functions will be disabled.	Need description.
8149	Error	Laser controller Dr Filter error. Laser functions will be disabled.	Need description.
8150	Error	Laser controller invalid maximum power error. Laser functions will be disabled.	Need description.
8153	Error	Laser controller load module CRC error. Laser functions will be disabled.	Need description.
8154	Error	Laser controller module requires calibration. Laser functions will be disabled.	Need description.
8200	Advisory	Laser controller probe removed while firing.	Need description.
8202	Advisory	Laser controller Dr. Filter disengaged while firing.	Need description.
8203	Advisory	Laser controller Dr. Filter disconnected while firing.	Need description.
8204	Advisory	Laser controller interlock opened while firing.	Need description.
8205	Advisory	Laser controller footswitch disconnected while firing.	Need description.
8207	Advisory	Laser controller port changed in Ready State.	Need description.
8208	Advisory	Laser controller Dr. Filter disengaged in Ready State.	Need description.
8209	Advisory	Laser controller Dr. Filter disconnected in Ready State.	Need description.
8210	Advisory	Laser controller interlock opened in Ready State.	Need description.
8211	Advisory	Laser controller footswitch removed in Ready State.	Need description.
8212	Advisory	Laser controller footswitch engaged when Ready requested.	Need description.
8213	Advisory	Laser controller user data CRC error.	Need description.
8214	Advisory	Laser controller Ready State denied: the filter is disengaged.	Need description.
8215	Advisory	Laser controller Ready State denied: there is no interlock.	Need description.

Error Code	Classification	Displayed Text	Discrepancy
8216	Advisory	Laser controller Ready State denied: there is no valid probe for the active port.	Need description.
8217	Advisory	Laser controller Ready State denied: the footswitch is depressed.	Need description.
8218	Advisory	Are all necessary Dr. Filters properly installed and connected?	User requests going to Ready Mode when the doctor filters haven't been verified.
8219	Advisory	Laser controller Ready State denied: there is no footswitch present.	User presses the Laser Ready button when no footswitch is connected.
8220	Advisory	Laser controller Dr. Filter connected while in Transition, Ready or Firing State.	User connects an engaged Dr. Filter while in Transition / Ready or Firing mode and and Endo probe is connected to the active port.

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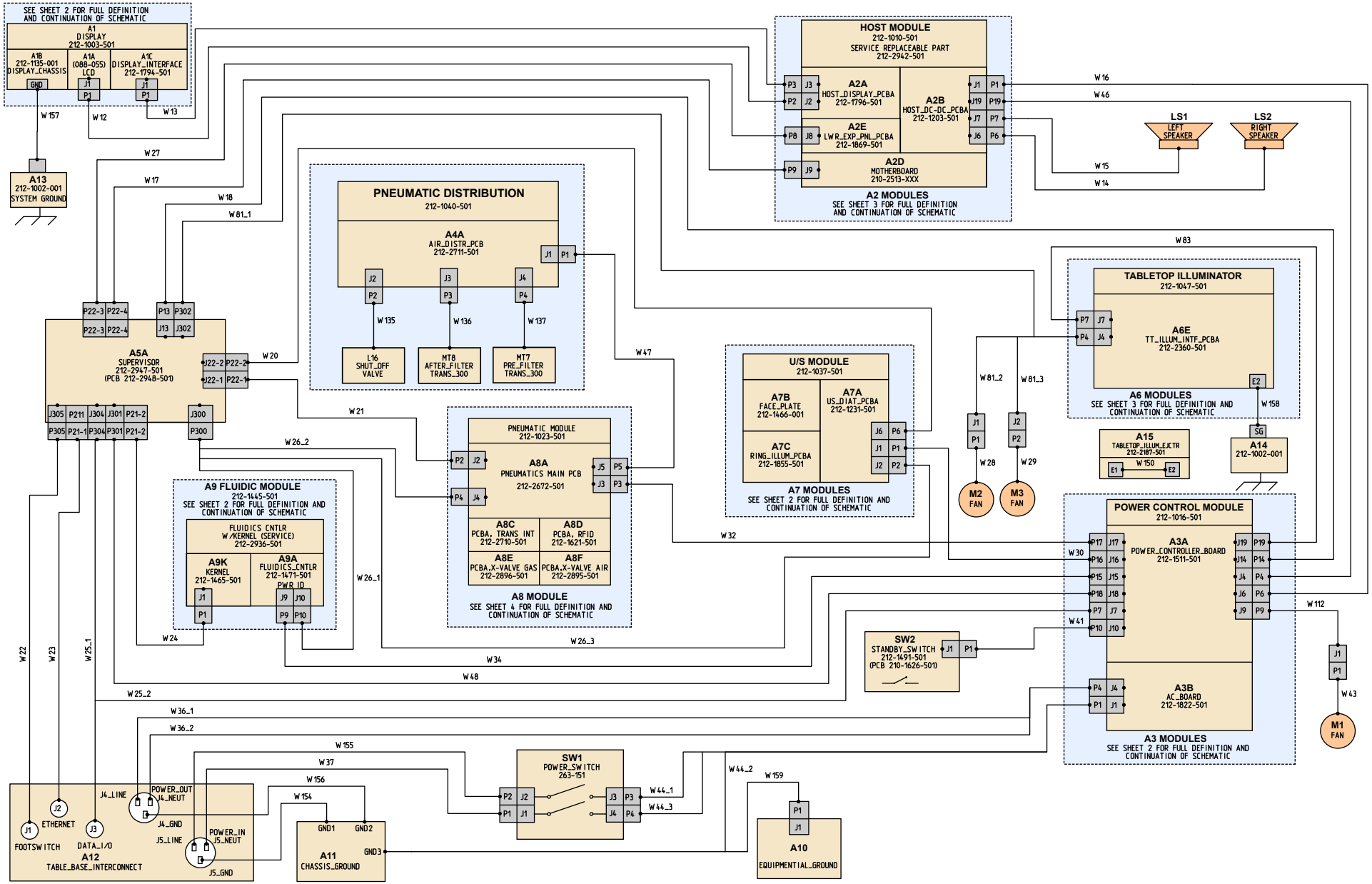
SECTION FIVE
SCHEMATICS



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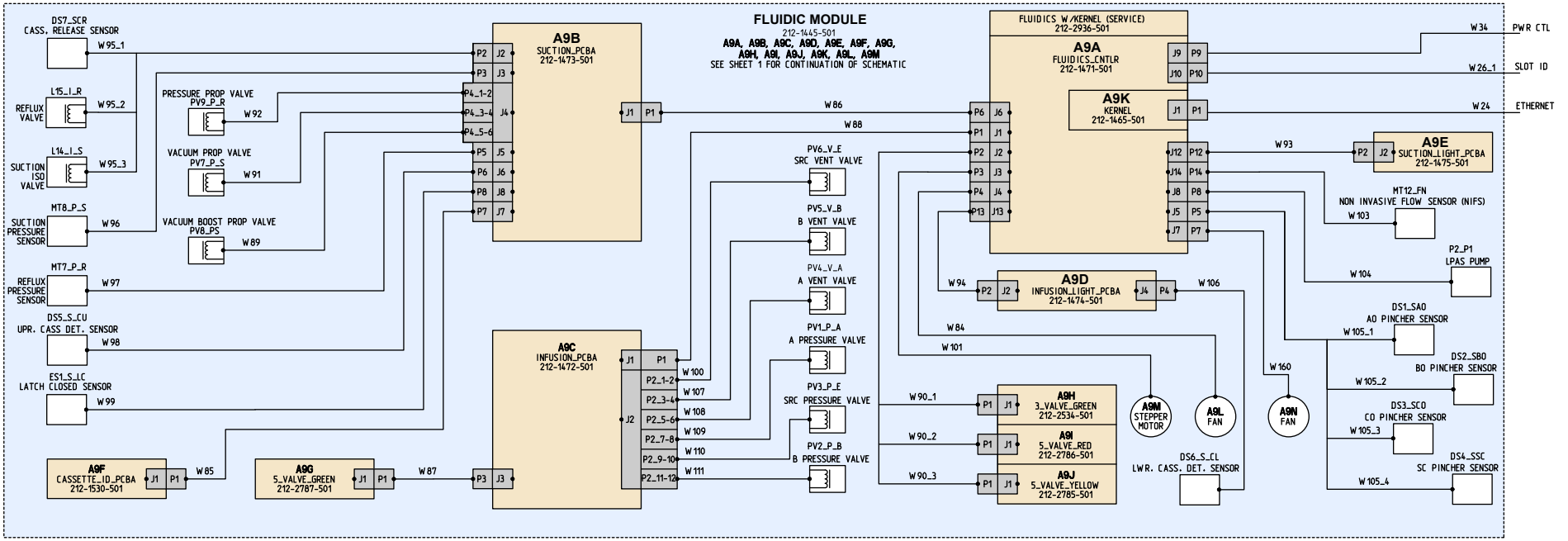

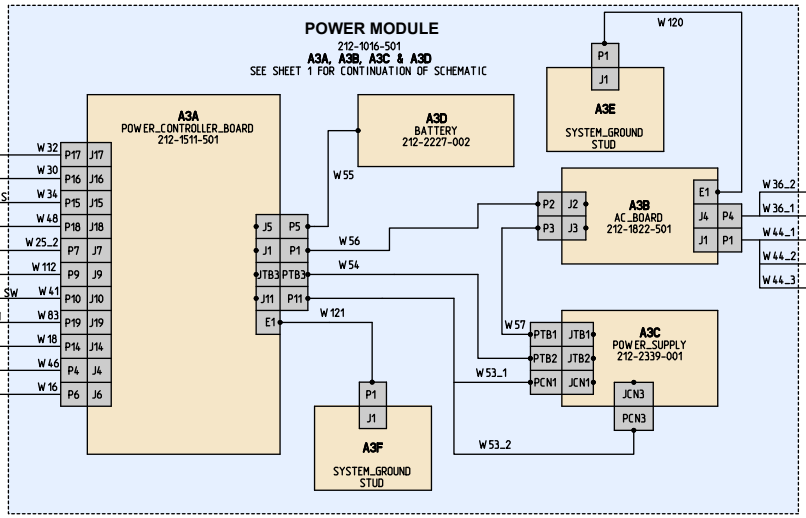

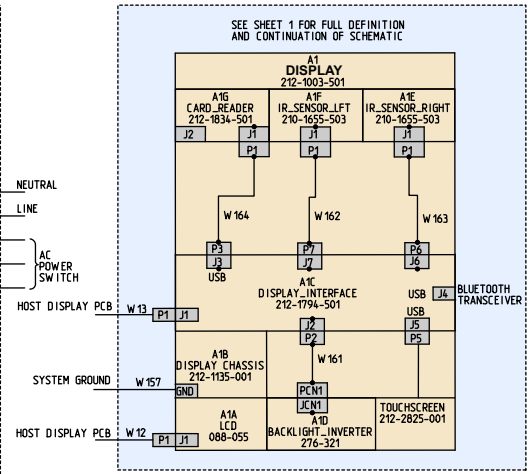

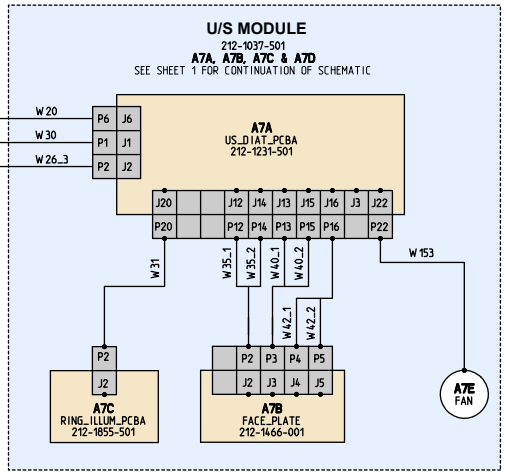

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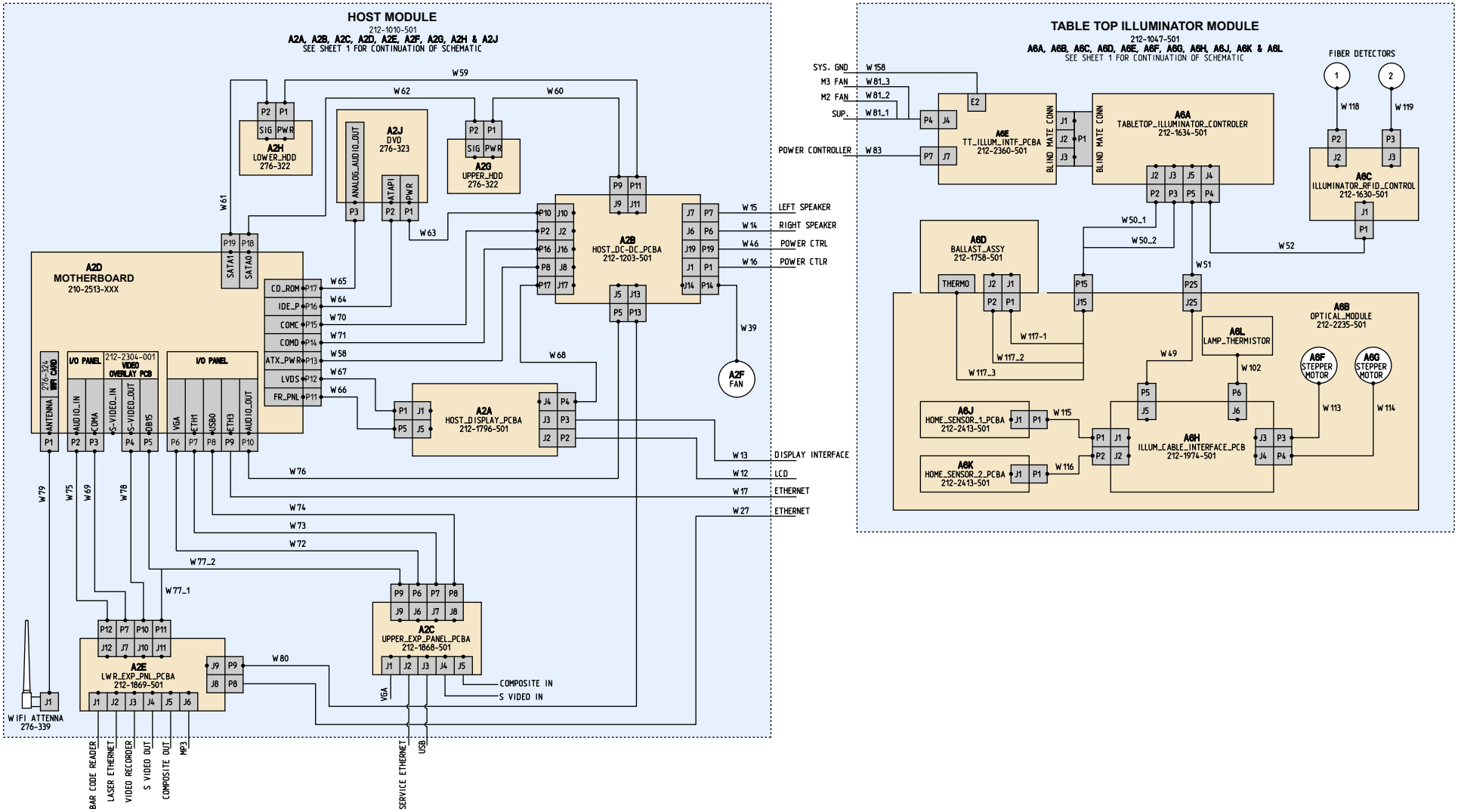
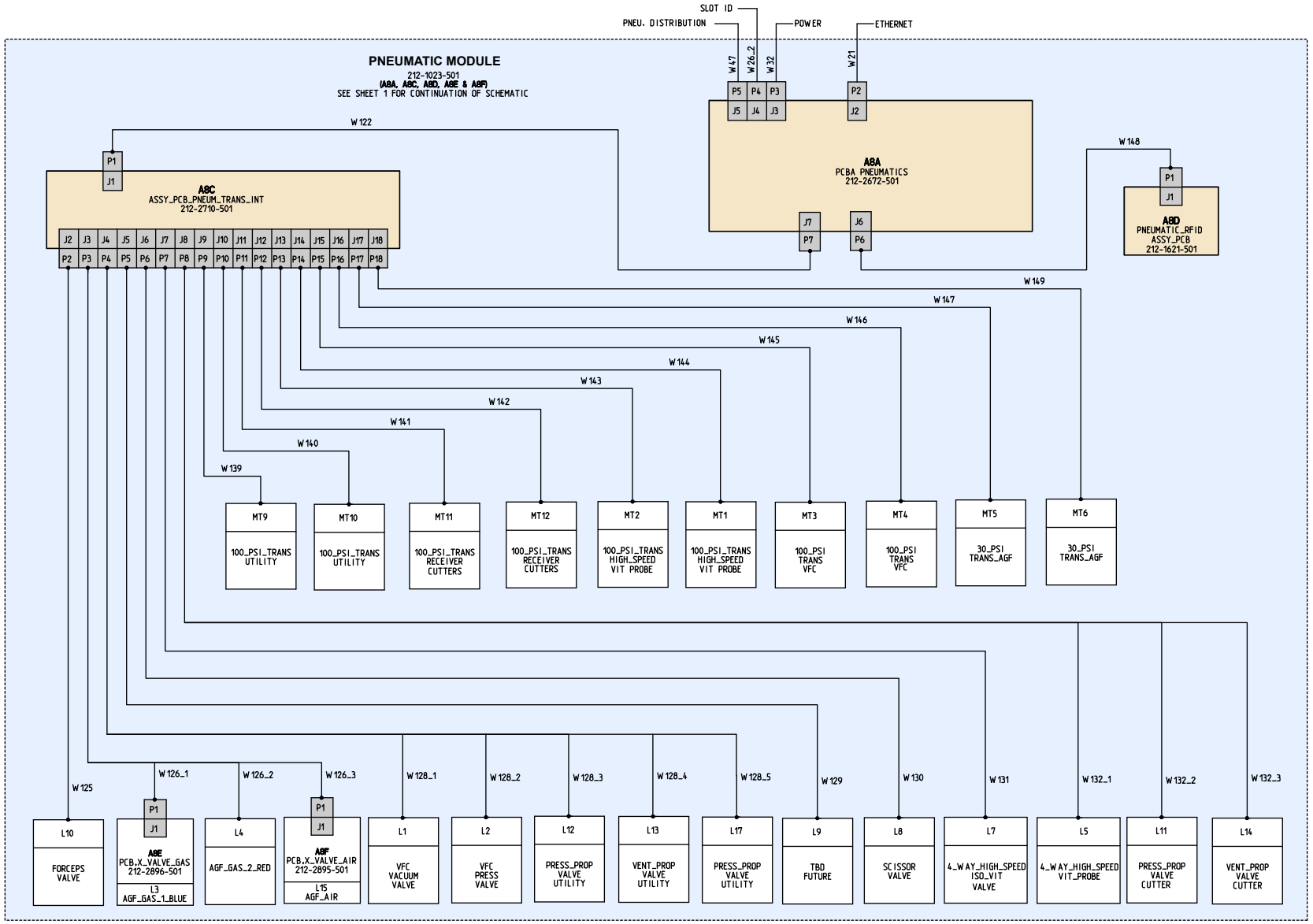


212-5002-801 System Console Interconnect Diagram (3 of 5)

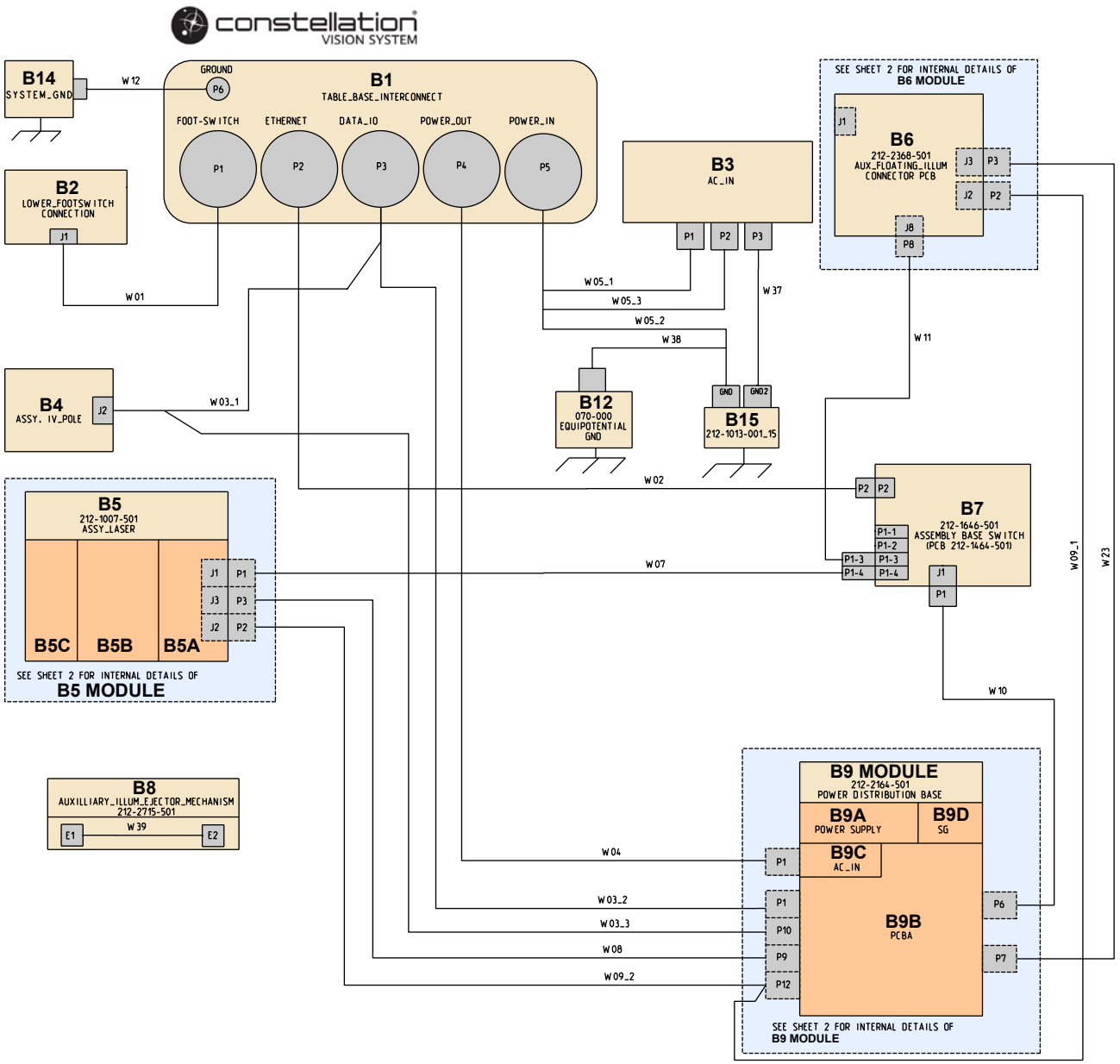


212-5002-801 System Console Interconnect Diagram (4 of 5)

constellation VISION SYSTEM

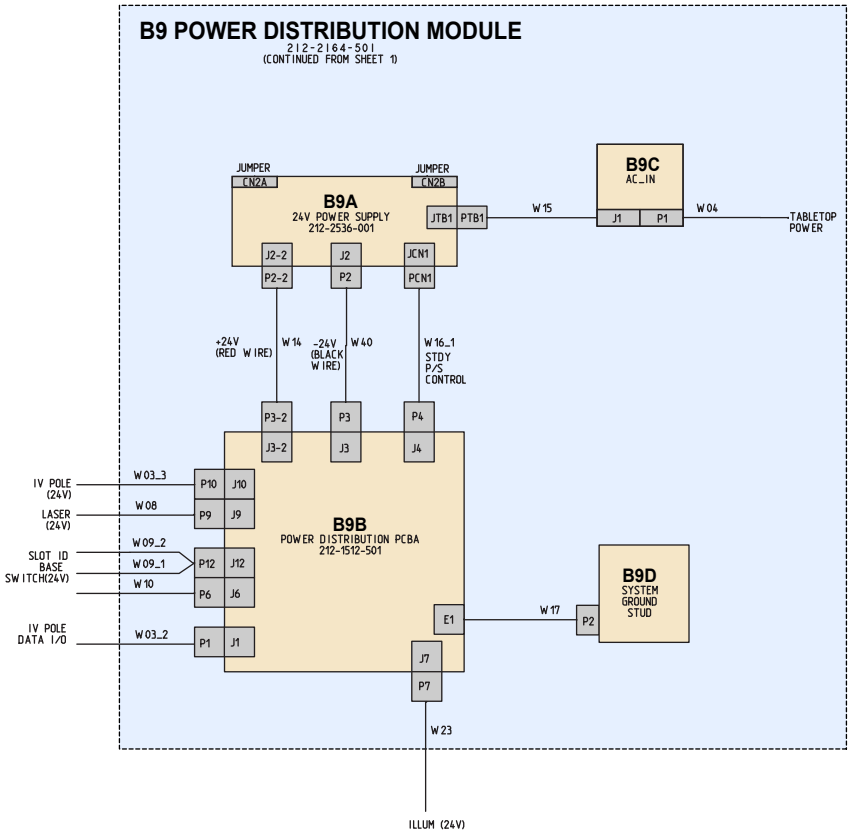
REF DES	CONNECTOR REF DES FROM MODULE/CONNECTOR	CONNECTOR REF DES TO MODULE/CONNECTOR	ALCON PART NUMBER	DESCRIPTION
W 100	A9CP2_1-2	PV6_V_E_VALVE	212-2634-001	CABLE ASSY.PROP VALVE.LW
W 101	A9AP3	A9M_MOTOR	212-2575-001	MOTOR,STEPPER W/ENCODER.W 101
W 102	A6HP6	A6L_SENSOR	212-2623-001	ASSY.CABLE.THERMISTOR,ILLUM
W 103	A9AP14	MT12_FN_SENSOR	212-2308-001	CABLE ASSY.SENSOR.FLOW.W 103
W 104	A9AP8	P2_P1_PUMP	212-2290-001	CABLE ASSY.LPAS PUMP.W 104
W 105_1	A9AP5	DS1_SAO_SENSOR	212-2284-001	CABLE ASSY.SENS.PINCHER W 105
W 105_2	A9AP5	DS2_SBO_SENSOR	212-2284-001	CABLE ASSY.SENS.PINCHER W 105
W 105_3	A9AP5	DS3_SCO_SENSOR	212-2284-001	CABLE ASSY.SENS.PINCHER W 105
W 105_4	A9AP5	DS4_SSC_SENSOR	212-2284-001	CABLE ASSY.SENS.PINCHER W 105
W 106	A9DP4	DS6_S_CL_SENSOR	212-2292-002	CABLE ASSY.CASS IN SENSOR.W 106
W 107	A9CP2_3-4	PV5_V_B_VALVE	212-2634-001	CABLE ASSY.PROP VALVE.LW
W 108	A9CP2_5-6	PV4_V_A_VALVE	212-2634-001	CABLE ASSY.PROP VALVE.LW
W 109	A9CP2_7-8	PV1_P_A_VALVE	212-2632-001	CABLE ASSY.PROP VALVE.3S
W 110	A9CP2_9-10	PV3_P_E_VALVE	212-2632-001	CABLE ASSY.PROP VALVE.3S
W 111	A9CP2_11-12	PV2_P_B_VALVE	212-2632-001	CABLE ASSY.PROP VALVE.3S
W 112	A3AP9	M1J1	212-2604-001	CABLE ASSY.FAN
W 113	A6HP3	A6F_MOTOR	212-2656-001	ASSY.CABLE.STEPPER MOTOR
W 114	A6HP4	A6G_MOTOR	212-2656-001	ASSY.CABLE.STEPPER MOTOR
W 115	A6HP1	A6JP1	212-2658-001	ASSY.CABLE.HOME SENSOR
W 116	A6HP2	A6KP1	212-2658-001	ASSY.CABLE.HOME SENSOR
W 117-1	A6BJ15	A6DP1	212-2655-001	ASSY.CABLE.BALLAST INTFC
W 117_2	A6BJ15	A6DP2	212-2655-001	ASSY.CABLE.BALLAST INTFC
W 117_3	A6BJ15	A6D_THERMO	212-2655-001	ASSY.CABLE.BALLAST INTFC
W 118	A6CP2	1_FIBER_DETECT	212-2266-001	ASSY.CABLE.FIBER.DETECT
W 119	A6CP3	2_FIBER_DETECT	212-2266-001	ASSY.CABLE.FIBER.DETECT
W 12	A2AP2	A1AP1	212-1871-001	ASSY.CABLE.VIDEO.LVDS
W 120	A3BE1	A3EP1	212-2223-002	CABLE. GND
W 121	A3AE1	A3FP1	212-2223-003	CABLE. GND
W 122	A8AP7	A8CP1	212-2596-001	CABLE ASSY.PNEU.INTERFACE.W 122
W 125	A8CP2	L10_	212-2591-001	CABLE ASSY.SMC VALVE
W 126_1	A8CP3	A8EP1	212-2747-001	CABLE ASSY.W 126
W 126_2	A8CP3	L4_	212-2747-001	CABLE ASSY.W 126
W 126_3	A8CP3	A8FP1	212-2747-001	CABLE ASSY.W 126
W 128_1	A8CP4	L1_	212-2748-001	CABLE ASSY.W 128
W 128_2	A8CP4	L2_	212-2748-001	CABLE ASSY.W 128
W 128_3	A8CP4	L12_	212-2748-001	CABLE ASSY.W 128
W 128_4	A8CP4	L13_	212-2748-001	CABLE ASSY.W 128
W 128_5	A8CP4	L17_	212-2748-001	CABLE ASSY.W 128
W 129	A8CP5	L9_	212-2591-001	CABLE ASSY.SMC VALVE
W 13	A1CP1	A2AP3	212-1872-001	ASSY.CABLE.INTERFACE,DISPLAY
W 130	A8CP6	L8_	212-2591-001	CABLE ASSY.SMC VALVE
W 131	A8CP7	L7_	212-2594-001	CABLE ASSY.VIT.W 131
W 132_1	A8CP8	L5_	212-2749-001	CABLE ASSY.W 132
W 132_2	A8CP8	L11_	212-2749-001	CABLE ASSY.W 132
W 132_3	A8CP8	L14_	212-2749-001	CABLE ASSY.W 132
W 135	A4AP2	L16_	212-2593-001	CABLE ASSY.SMC VALVE
W 136	A4AP3	MT8_	212-2588-001	CABLE ASSY.PRESS SNSR 300
W 137	A4AP4	MT7_	212-2588-001	CABLE ASSY.PRESS SNSR 300
W 139	A8CP9	MT9_	212-2590-001	ASSY.CABLE.PRESS SNSR 100
W 14	A2BP6	SPEAKER_LS2	212-2383-001	CABLE ASSY.SATA SIG.W 61/W 62
W 140	A8CP10	MT10_	212-2590-001	ASSY.CABLE.PRESS SNSR 100
W 141	A8CP11	MT11_	212-2590-001	ASSY.CABLE.PRESS SNSR 100
W 142	A8CP12	MT12_	212-2590-001	ASSY.CABLE.PRESS SNSR 100
W 143	A8CP13	MT2_	212-2590-001	ASSY.CABLE.PRESS SNSR 100
W 144	A8CP14	MT1_	212-2590-001	ASSY.CABLE.PRESS SNSR 100
W 145	A8CP15	MT3_	212-2590-001	ASSY.CABLE.PRESS SNSR 100
W 146	A8CP16	MT4_	212-2590-001	ASSY.CABLE.PRESS SNSR 100
W 147	A8CP17	MT5_	212-2589-001	CABLE ASSY.PRESS SNSR 30
W 148	A8AP6	A8DP1	212-2595-001	CABLE ASSY.RFID.W 148
W 149	A8CP18	MT6_	212-2589-001	CABLE ASSY.PRESS SNSR 30
W 15	A2BP7	SPEAKER_LS1	212-1557-002	ASSY.CABLE.LEFT SPEAKER
W 150	A15E1	A15E2	212-2957-002	CABLE ASSY.GND.TT ILLUM EJCTR
W 153	A7E_FAN	A7AP22	212-2274-002	ASSY.CABLE.FAN
W 154	A12J5_GND	A11GND1	212-1580-002	ASSY.CABLE.W 154,AC IN
W 155	A12J5_LINE	SW 1P2	212-1580-003	ASSY.CABLE.W 155,AC IN
W 156	A12J4_GND	A11GND2	212-1580-004	ASSY.CABLE.W 156,AC IN
W 157	A1BGND	A13SG	212-2281-001	ASSY.GROUND STRAP,DISPLAY
W 158	A6EE2	A14SG	212-2667-001	ASSY.CABLE.ILLUM GROUND STRAP
W 159	A11GND3	A10P1	212-1580-005	ASSY.CABLE.W 159,GROUND
W 16	A3AP6	A2BP1	212-1559-001	ASSY.CABLE.HOST INTERFACE W 16
W 160	A9AP7	A9N_FAN	212-2937-001	CABLE ASSY.FLUIDICS FAN
W 161	A1CP2	A1DPCN1	212-1873-001	CABLE ASSY. DISPLAY, BLT INVERT
W 162	A1CP7	A1FP1	212-1874-001	CABLE ASSY. DISPLAY,IR SNSR RT
W 163	A1CP6	A1EP1	212-1874-002	CABLE ASSY. DISPLAY,IR SNSR LFT
W 164	A1CP3	A1GP1	212-1876-001	CABLE ASSY. DISP. SD CARD READER
W 17	A2DP9	A5AP22-4	212-1560-001	ASSY.CABLE.ETHERNET W 17
W 18	A5AP13	A3AP14	212-1561-001	CABLE ASSY.24V.DC W 18
W 20	A5AP22-2	A7AP6	212-1560-002	ASSY.CABLE.ETHERNET.U/S
W 21	A8AP2	A5AP22-1	212-1560-003	ASSY.CABLE.ETHERNET.PNEU
W 22	A5AP305	A12J1	212-1565-001	ASSY.CABLE.W 22,FOOTSWITCH
W 23	A5AP21-1	A12J2	212-1566-001	ASSY.CABLE.W 23,ETHERNET TO BASE
W 24	A5AP21-2	A9KP1	212-1560-004	ASSY.CABLE.ETHERNET,FLUIDICS
W 25_1	A5AP304	A12J3	212-1568-001	ASSY.CABLE.W 25,DATA I/O
W 25_2	A12J3	A3AP7	212-1568-001	ASSY.CABLE.W 25,DATA I/O
W 26_1	A9AP10	A5AP300	212-1569-001	ASSY.CABLE.SLOT ID
W 26_2	A8AP4	A5AP300	212-1569-001	ASSY.CABLE.SLOT ID
W 26_3	A7AP2	A5AP300	212-1569-001	ASSY.CABLE.SLOT ID
W 27	A2EP8	A5AP22-3	212-1560-008	ASSY.CABLE.ETHERNET W 27
W 28	M2_FAN	M2P1	212-2267-001	CABLE ASSY.FAN.W 28
W 29	M3_FAN	M3P2	212-2268-001	CABLE ASSY.FAN.W 29
W 30	A3AP16	A7AP1	212-1561-004	CABLE ASSY.24V.DC W 30
W 31	A7AP20	A7CP1	212-2269-001	ASSY. CABLE.U/S RING ILLUM.W 31
W 32	A8AP3	A3AP17	212-1561-005	CABLE ASSY.24V.DC W 32
W 34	A3AP15	A9AP9	212-1561-006	CABLE ASSY.24V.DC W 34
W 35_1	A7BP2	A7AP12	212-2271-001	ASSY. CABLE. U/S.W 35
W 35_2	A7BP2	A7AP14	212-2271-001	ASSY. CABLE. U/S.W 35
W 36_1	A3BP4	A12J4_LINE	212-1579-001	CABLE ASSY.W 36,AC OUTPUT
W 36_2	A3BP4	A12J4_NEUT	212-1579-001	CABLE ASSY.W 36,AC OUTPUT
W 37	A12J5_NEUT	SW 1P1	212-1580-001	ASSY.CABLE.W 37,AC IN
W 39	A2F_FAN	A2BP14	212-2332-001	ASSY.CABLE.HOST FAN.W 39
W 40_1	A7BP3	A7AP13	212-2271-002	ASSY. CABLE. U/S.W 40
W 40_2	A7AP15	A7BP3	212-2271-002	ASSY. CABLE. U/S.W 40
W 41	A3AP10	SW 2P1	212-1584-001	ASSY.CABLE.STANDBY SW W 41
W 42_1	A7BP4	A7AP16	212-2273-001	ASSY. CABLE. DIATHERMY.W 42
W 42_2	A7BP5		212-2273-001	ASSY. CABLE. DIATHERMY.W 42
W 43	M1_FAN	M1P1	212-1586-001	CABLE ASSY.FAN.W 43
W 44_1	A3BP1	SW 1P3	212-1587-001	CABLE ASSY.W 44,AC IN BREAKER
W 44_2	A3BP1	A11GND3	212-1587-001	CABLE ASSY.W 44,AC IN BREAKER
W 44_3	A3BP1	SW 1P4	212-1587-001	CABLE ASSY.W 44,AC IN BREAKER
W 46	A3AP4	A2BP19	212-1589-001	ASSY.CABLE.24V DC W 46
W 47	A8AP5	A4AP1	212-2062-001	ASSY.CABLE.PNEU DIST W 47
W 48	A3AP18	A5AP301	212-2063-001	ASSY.CABLE.SUPERVISOR INF W 48
W 49	A6HP5	A6BJ25	212-2531-001	CABLE.CIRCUIT,FLEX ILLUM TT
W 50_1	A6BP15	A6AP2	212-2198-001	ASSY.CABLE.ILLUM BALLAST TOP
W 50_2	A6BP15	A6AP3	212-2198-001	ASSY.CABLE.ILLUM BALLAST TOP
W 51	A6AP5	A6BP25	212-2196-001	ASSY.CABLE.ILLUM OPT INTFC
W 52	A6AP4	A6CP1	212-2199-001	ASSY.CABLE.ILLUM RFID INTF W 52
W 53_1	A3AP11	A3CPCN1	212-2257-001	ASSY.CABLE.W 53,PWR SUP CNTRL
W 53_2		A3CPCN3	212-2257-001	ASSY.CABLE.W 53,PWR SUP CNTRL
W 54	A3APTB3	A3CPTB2	212-2258-001	ASSY.CABLE.W 54,DC POWER.MAIN
W 55	A3AP5	A3D_BATT	212-2227-001	BATTERY,POWER MODULE
W 56	A3AP1	A3BP2	212-2260-001	ASSY.CABLE.W 56,AC CONTROL
W 57	A3BP3	A3CPTB1	212-2261-001	ASSY.CABLE.W 57,AC POWER
W 58	A2DP13	A2BP8	212-2381-001	ASSY.CABLE.ATX POWER W 58
W 59	A2BP11	A2HP1	212-2382-001	CABLE ASSY.SATA PWR.W 59/W 60
W 60	A2BP9	A2GP1	212-2382-001	CABLE ASSY.SATA PWR.W 59/W 60
W 61	A2DP19	A2HP2	212-2383-001	CABLE ASSY.SATA SIG.W 61/W 62
W 62	A2DP18	A2GP2	212-2383-001	CABLE ASSY.SATA SIG.W 61/W 62
W 63	A2JP1	A2BP10	212-2384-001	ASSY.CABLE.DVD POWER, W 63
W 64	A2DP16	A2JP2	212-2385-001	ASSY. CABLE. IDE SIGNAL, W 64
W 65	A2DP17	A2JP3	212-2386-001	ASSY. CABLE. CD-ROM AUDIO. W 65
W 66	A2DP11	A2AP5	212-2387-001	ASSY.CABLE,FRONT PANEL USB W 66
W 67	A2DP12	A2AP1	212-2388-001	CABLE ASSY.LVDS SIGNAL.W 67
W 68	A2BP17	A2AP4	212-2389-001	ASSY.CABLE,PWR FR PNL W 68
W 69	A2DP3	A2EP7	212-2390-001	CABLE ASSY.SERIAL.IO EXT W 69
W 70	A2DP15	A2BP2	212-2391-001	CABLE ASSY.SERIAL.EXT 12.5 W 70
W 71	A2DP14	A2BP16	212-2391-002	ASSY.CABLE.SERIAL,EXT 16.0 W 71
W 72	A2DP6	A2CP6	212-2392-001	CABLE ASSY.VGA,EXT W 72
W 73	A2DP7	A2CP7	212-2393-001	CABLE ASSY.ETHRNT EXTN.W 73
W 74	A2DP8	A2CP8	212-2394-001	CABLE ASSY.USB.PORT EXT W 74
W 75	A2DP2	A2EP12	212-2395-001	CABLE ASSY.AUDIO EXT W 75/W 76
W 76	A2DP10	A2BP5	212-2395-001	CABLE ASSY.AUDIO EXT W 75/W 76
W 77_1	A2DP5	A2EP11	212-2396-001	CABLE ASSY.VGM SIGNAL,EXT W 77
W 77_2	A2DP5	A2CP9	212-2396-001	CABLE ASSY.VGM SIGNAL,EXT W 77
W 78	A2DP4	A2EP10	212-2397-001	CABLE ASSY.S-VIDEO.OUT EXT W 78
W 79	A2DP1	ANT_J1	212-2389-001	ASSY.CABLE,PWR FR PNL W 68
W 80	A2BP13	A2EP9	212-2399-001	ASSY.CABLE.EXPNSN PWR SGNL.W 80
W 81_1	A5AP302	A6EP4	212-2499-001	CABLE ASSY.I/O CONTROL W 81
W 81_2	A6EP4	M2J1	212-2499-001	CABLE ASSY.I/O CONTROL W 81
W 81_3	A6EP4	M3J2	212-2499-001	CABLE ASSY.I/O CONTROL W 81
W 83	A6EP7	A3AP19	212-1561-002	CABLE ASSY.24V.DC W 83
W 84	A9AP4	A9L_FAN	212-2937-001	CABLE ASSY.FLUIDICS FAN
W 85	A9BP7	A9FP1	212-2293-001	CABLE ASSY.CASSETTE ID.W 85
W 86	A9AP6	A9BP1	212-2291-001	CABLE ASSY.SUCTION CONTR..W 86
W 87	A9CP3	A9GP1	023-095	CABLE,FLAT,IDC SOCKET,2MM
W 88	A9AP1	A9CP1	212-2252-001	CABLE ASSY.INF CONTROLLER W 88
W 89	A9BP4_5-6	PV8_PS_VALVE	212-2633-001	CABLE ASSY.PROP VALVE.5S
W 90_1	A9AP2	A9HP1	212-2288-001	CABLE ASSY.X-VALVE
W 90_2	A9AP2	A9IP1	212-2288-001	CABLE ASSY.X-VALVE
W 90_3	A9AP2	A9JP1	212-2288-001	CABLE ASSY.X-VALVE
W 91	A9BP4_3-4	PV7_P_S_VALVE	212-2633-001	CABLE ASSY.PROP VALVE.5S
W 92	A9BP4_1-2	PV9_P_R_VALVE	212-2632-001	CABLE ASSY.PROP VALVE.3S
W 93	A9AP12	A9EP2	023-091	CABLE,RIBBON,20 COND,20 INCH
W 94	A9AP13	A9DP2	023-092	CABLE,RIBBON,26 COND,20 INCH
W 95_1	A9BP2	DS7_SCR_SENSOR	212-2294-001	CABLE ASSY.SMC CASS-REL.W 95
W 95_2	A9BP2	L15_I_R_	212-2294-001	CABLE ASSY.SMC CASS-REL.W 95
W 95_3	A9BP2	L14_I_S_	212-2294-001	CABLE ASSY.SMC CASS-REL.W 95
W 96	A9BP3	MT8_P_S_	212-2580-001	SENSOR,PRESSURE,ABS 30
W 97	A9BP5	MT7_P_R_	212-2579-001	SENSOR,PRESSURE,ABS 100
W 98	A9BP6	DS5_S_CU_SENSOR	212-2292-001	CABLE ASSY.CASS IN SENSOR.W 98
W 99	A9BP8	ES1_S_LC_SENSOR	212-2272-001	CABLE ASSY.LATCH POS.W 99

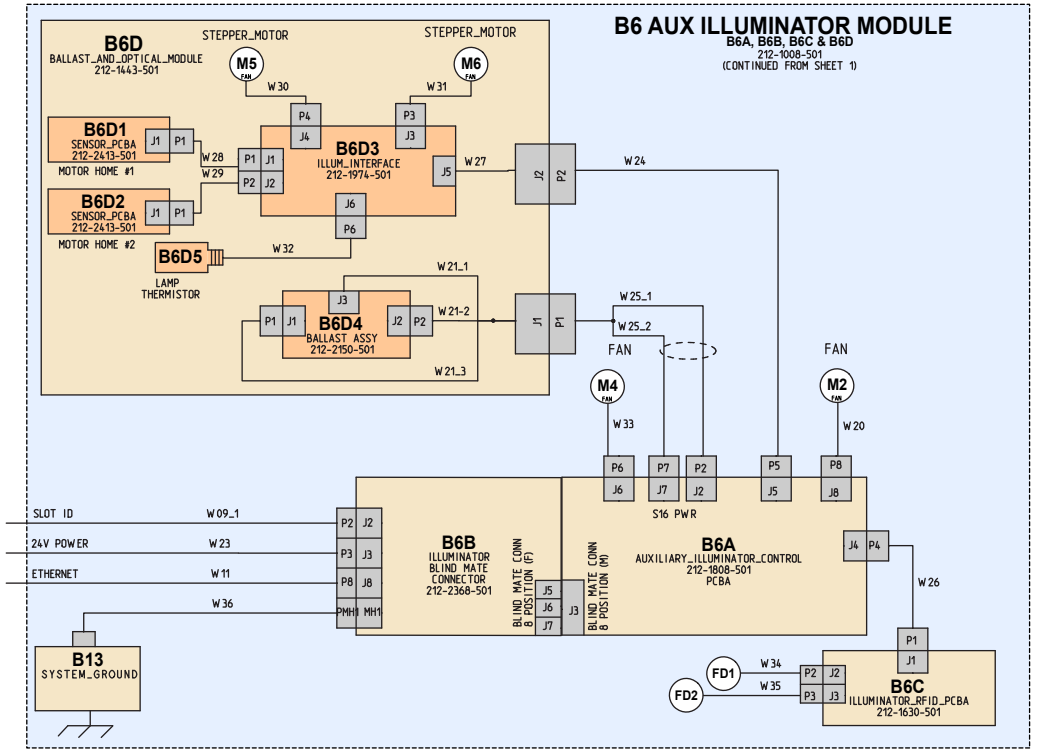
212-5002-801 System Console Interconnect Diagram (5 of 5)

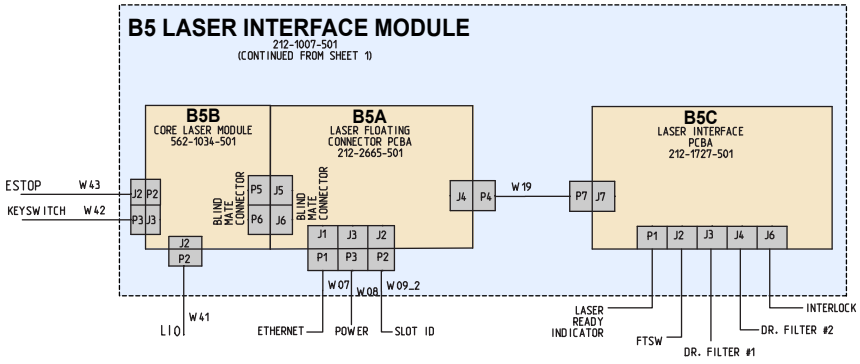


REF DES	CONNECTOR REF DES FROM	CONNECTOR REF DES TO	ALCON PART NUMBER	DESCRIPTION
	MODULE/CONNECTOR	MODULE/CONNECTOR		
W01	B1P1	B2J1	212-1678-001	CABLE, W01, FOOT SWITCH
W02	B1P2	B7P2	212-1560-009	CABLE, W02, ETHERNET
W03_1	B1P3	B4J2	212-1680-001	CABLE, W03, DATA IO
W03_2	B1P3	B9BP1	212-1680-001	CABLE, W03, DATA IO
W03_3	B4J2	B9BP10	212-1680-001	CABLE, W03, DATA IO
W04	B1P4	B9CP1	212-1681-001	CABLE, W04, POWER_OUT
W05_1	B1P5	B3P1	212-2201-001	CABLE, W05,AC POWER IN
W05_2	B1P5	B15GND	212-2201-001	CABLE, W05,AC POWER IN
W05_3	B3P2	B1P5	212-2201-001	CABLE, W05,AC POWER IN
W07	B7P1-4	B5AP1	212-1560-007	CABLE, W07, ETHERNET
W08	B5AP3	B9BP9	212-1561-008	CABLE, W08, 24V DC
W09_1	B6BP2	B9BP12	212-1689-001	CABLE, W09, SLOT ID
W09_2	B9BP12	B5AP2	212-1689-001	CABLE, W09, SLOT ID
W10	B7P1	B9BP6	212-1561-009	CABLE, W10, 24V DC
W11	B6BP8	B7P1-3	212-1560-006	CABLE, W11, ETHERNET
W12	B14SG	B1P6	212-2019-001	EQUI GROUND CABLE
W14	B9BP3-2	B9AP2-2	212-2220-001	CABLE, W14, DC POWER
W15	B9APTB1	B9CJ1	212-2221-001	CABLE, W15, AC IN
W16_1	B9BP4	B9APCN1	212-2222-001	CABLE, W16, PS CONTROL
W17	B9BE1	B9DP2	212-2223-001	CABLE, W17, GROUND
W19	B5AP4	B5CP7	212-1996-501	CABLE, W19, LASER INTERFACE
W20	M2FAN	B6AP8	212-2268-002	CABLE, W20, FAN OPTICS
W21-2	B6DJ15	B6D4P2	212-2655-001	CABLE, W21, BALLAST INTERFACE
W21_1	B6DJ15	B6D4J3	212-2655-001	CABLE, W21, BALLAST INTERFACE
W21_3	B6DJ15	B6D4P1	212-2655-001	CABLE, W21, BALLAST INTERFACE
W23	B6BP3	B9BP7	212-1561-010	CABLE, W23, 24V DC
W24	B6DP7	B6AP5	212-2196-001	CABLE, W24,ILLUM OPT INTF
W25_1	B6DP15	B6AP2	212-2198-002	CABLE, W25, BALLAST INTERFACE
W25_2	B6DP15	B6AP7	212-2198-002	CABLE, W25, BALLAST INTERFACE
W26	B6AP4	B6CP1	212-2199-001	CABLE, W26, AUX ILLUM RFID
W27	B6D3J5	B6DJ7	212-2657-501	CABLE, W27, FLEX AUX ILLUM
W28	B6D1P1	B6D3P1	212-2658-001	CABLE, W28, HOME POS. SENSOR
W29	B6D2P1	B6D3P2	212-2658-001	CABLE, W29, HOME POS. SENSOR
W30	M5FAN	B6D3P4	212-2656-001	CABLE, W30, STEPPER MOTOR
W31	M6FAN	B6D3P3	212-2656-001	CABLE, W31, STEPPER MOTOR
W32	B6D3P6	B6D5GND	212-2623-001	CABLE, W32, THERMAL SENSOR
W33	M4FAN	B6AP6	212-2267-003	CABLE, W33, FAN BALLAST
W34	B6CP2	FD1P1	212-2266-001	CABLE, W34, FIBER DETECT
W35	B6CP3	FD2P1	212-2266-001	CABLE, W35, FIBER DETECT
W36	B6BPMH1	B13SG	212-2223-004	CABLE, W36, GROUND
W37	B3P3	B15GND2	212-2832-001	CABLE, W37, GROUND
W38	B15GND	B12SG	212-2833-001	CABLE, W38, GROUND
W39	B8E1	B8E2	212-2957-001	CABLE, W39, GND,AUX ILLUM EJCTR
W40	B9BP3	B9AP2	212-2220-002	CABLE.W40,DC POWER BLACK
W41	B5BP2	LIO	212-2685-001	CABLE,LIO
W42	B5BP3	KEYSWITCH	212-2686-001	CABLE,ASSY,KEYSWITCH
W43	B5BJ2	ESTOP	212-2663-001	CABLE,ASSY,ESTOP

212-5003-801 System Base Interconnect Diagram (1 of 2)

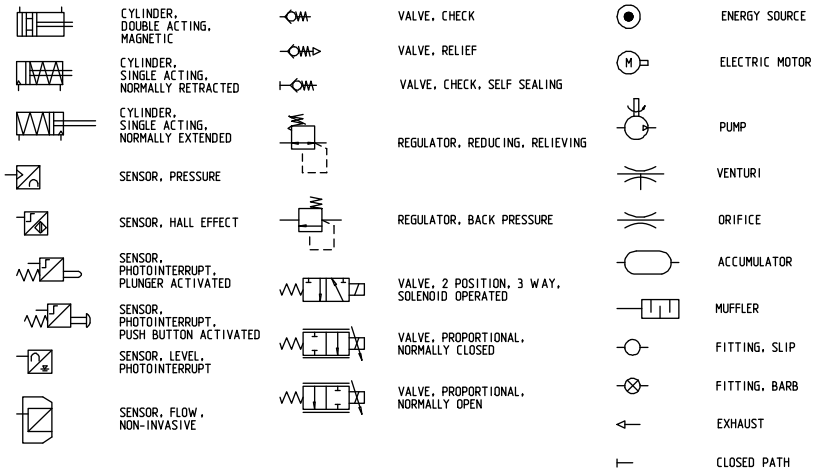


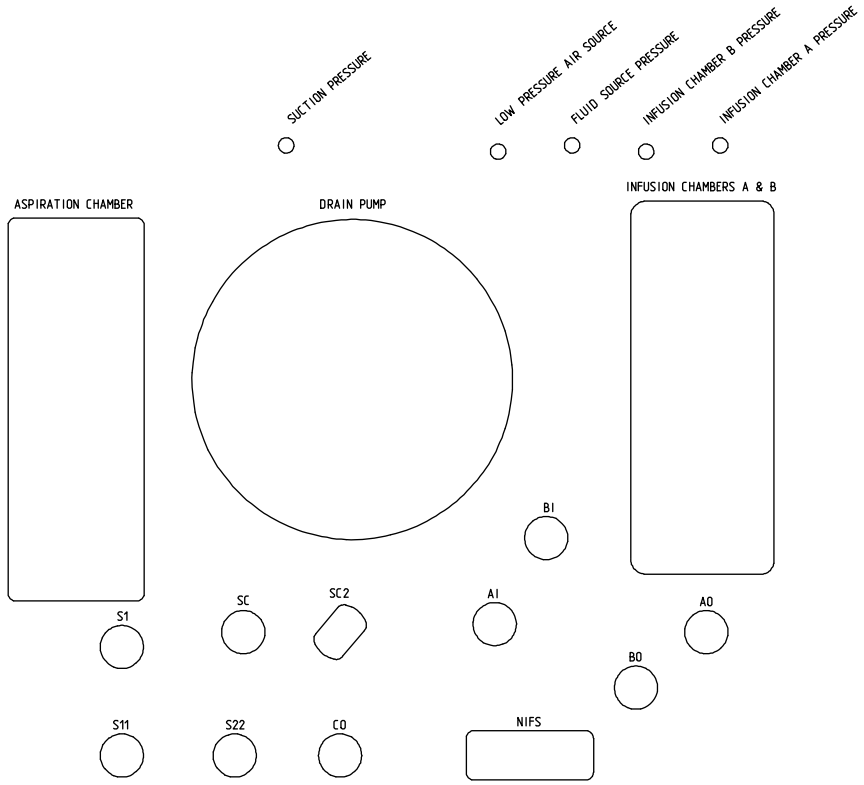




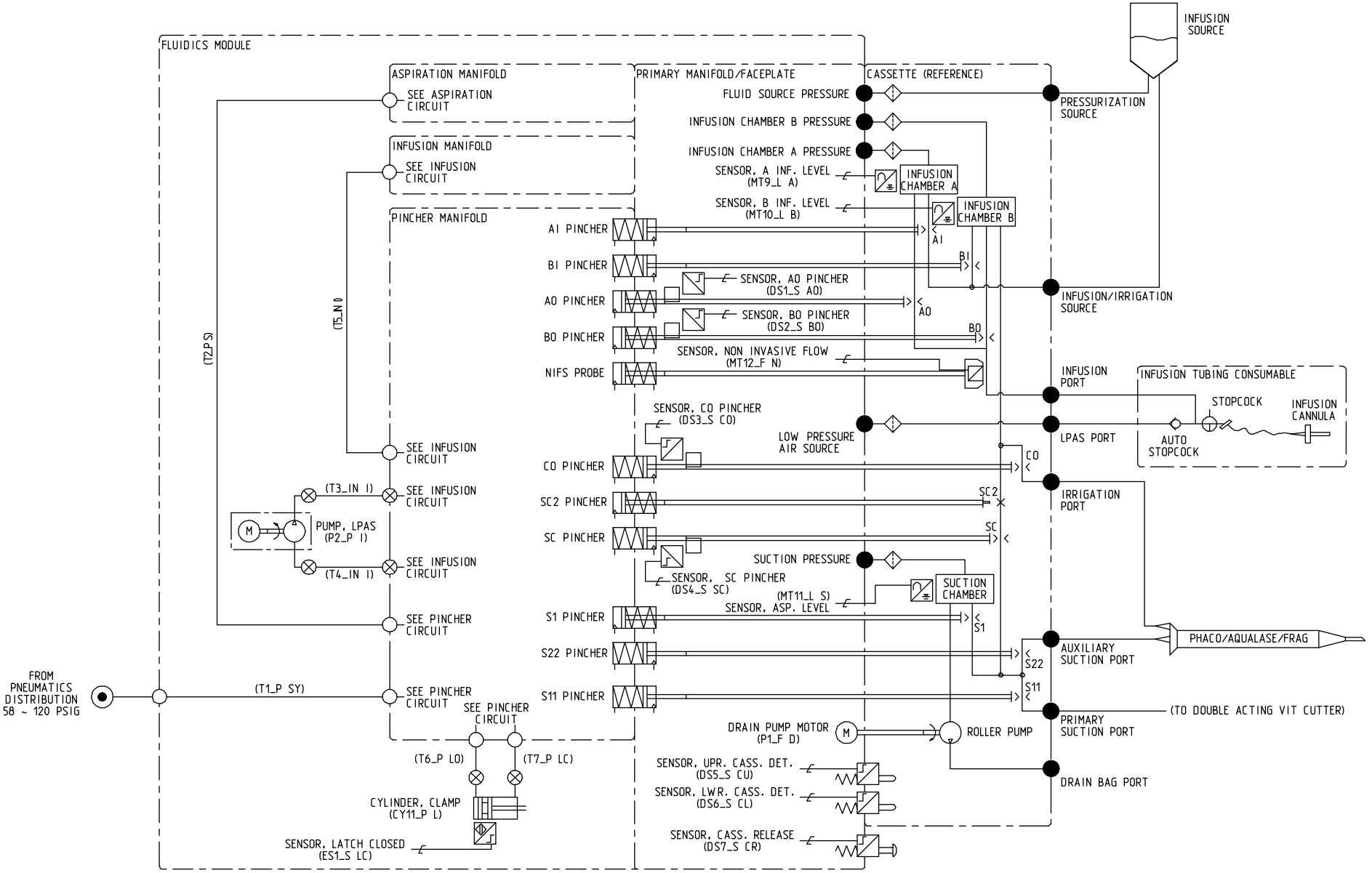
212-5003-801 System Base Interconnect Diagram (2 of 2)

COMPONENT DESCRIPTION TTNN_FF LL					
TT, TYPE	LAST USED	NOT USED	NN, NUMBER	FF, FUNCTION	LL, LOCATION
AC = ACCUMULATOR	AC4	--	1	F = FLOW	A [I] [O] = INFUSION CIRCUIT A [IN] [OUT]
CV = CHECK VALVE	CV1	--	2	I = ISOLATION	B [I] [O] = INFUSION CIRCUIT B [IN] [OUT]
CY = CYLINDER	CY12	--	3	IN = INTAKE	BA = INFUSION BACKUP
DS = INTERRUPT SENSOR	DS7	--	ETC	L = LEVEL	CO = IRRIGATION
ES = HALL EFFECT SENSOR	ES1	--		P = PRESSURE	C [L] [U] [R] = CASSETTE [LWR] [UPR] [RELEASE]
L = SOLENOID VALVE	L20	--		S = POSITION	D = DRAIN PUMP
MF = MUFFLER	MF2	--		V = VENT	E = SOURCE PRESSURIZATION
MT = MEASURING TRANSDUCER	MT12	--			F = F/AX
P = PUMP	P2	--			I = INFUSION SUPPLY
PV = PROPORTIONAL VALVE	PV9	--			L [O] [C] = LATCH [OPEN] [CLOSED]
RG = REGULATOR	RG5	--			N = NIFS
RO = RESTRICTIVE ORIFICE	RO2	--			P = PINCHER SUPPLY
RV = RELIEF VALVE	RV3	--			R = REFLUX
T = TUBING	T7	--			S = SUCTION
TP = TEST POINT	TP5	--			SC = CROSS CONNECTION
V = VENTURI	V1	--			SY = SYSTEM SUPPLY



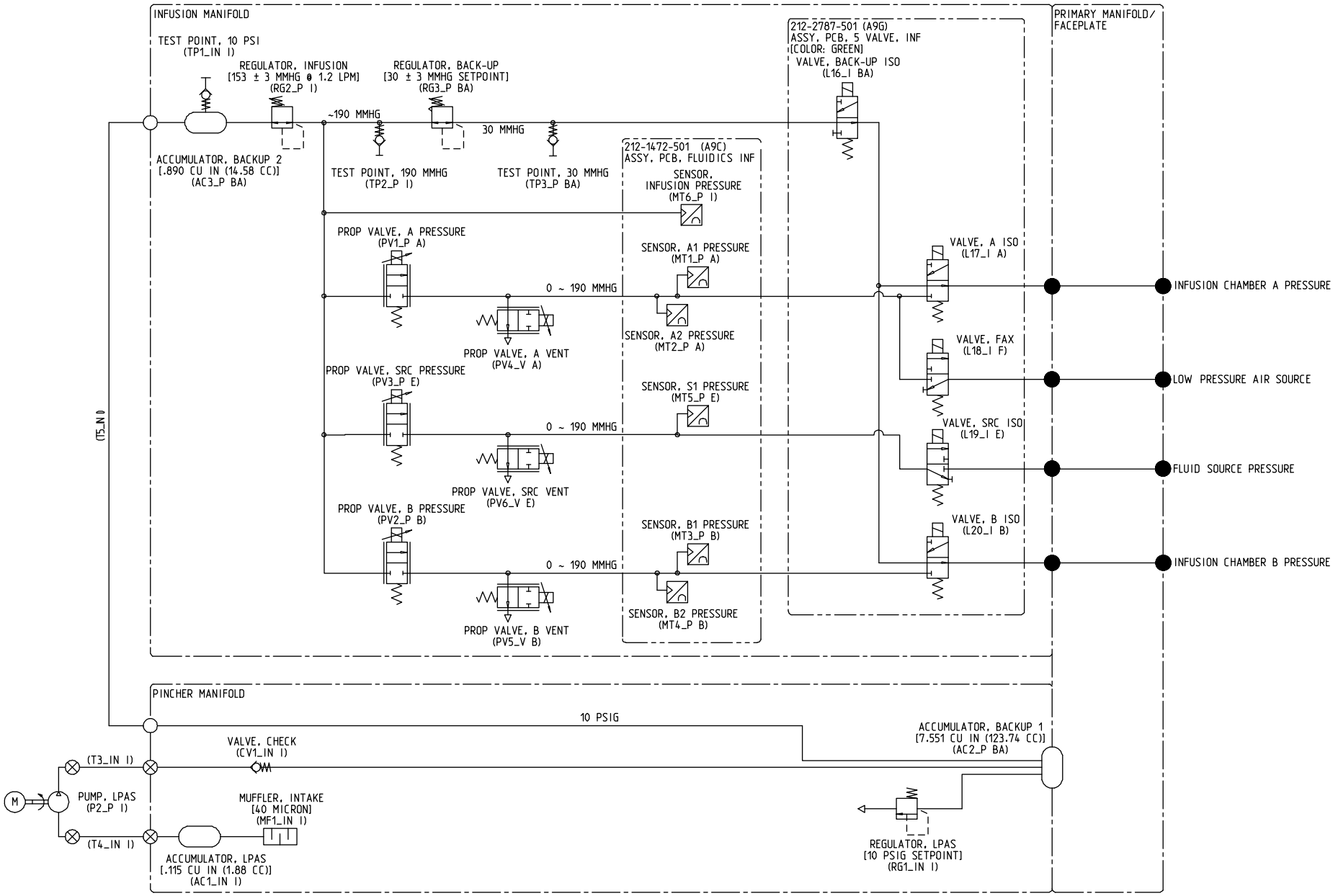


FACEPLATE INTERFACE



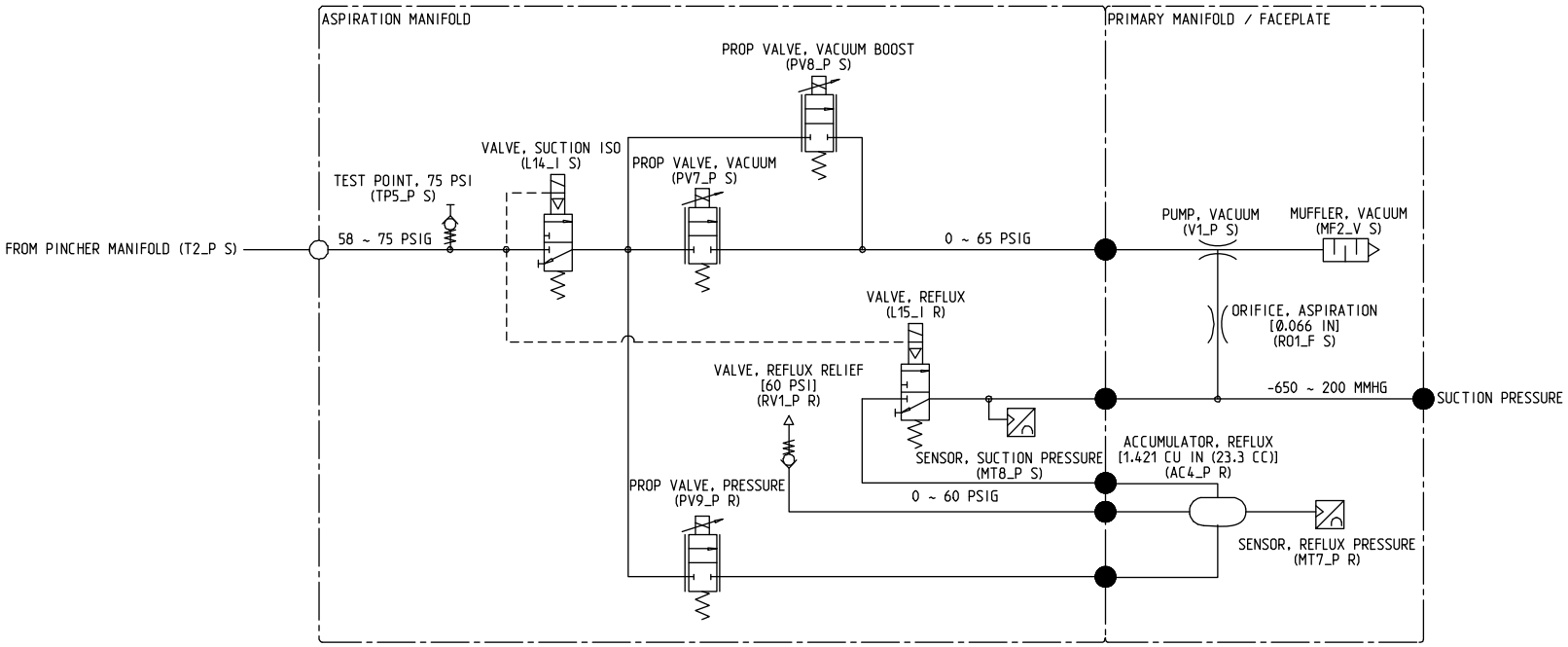
EXTERNAL CONNECTIONS

212-1445-801 **Fluidics Diagram (2 of 5)**

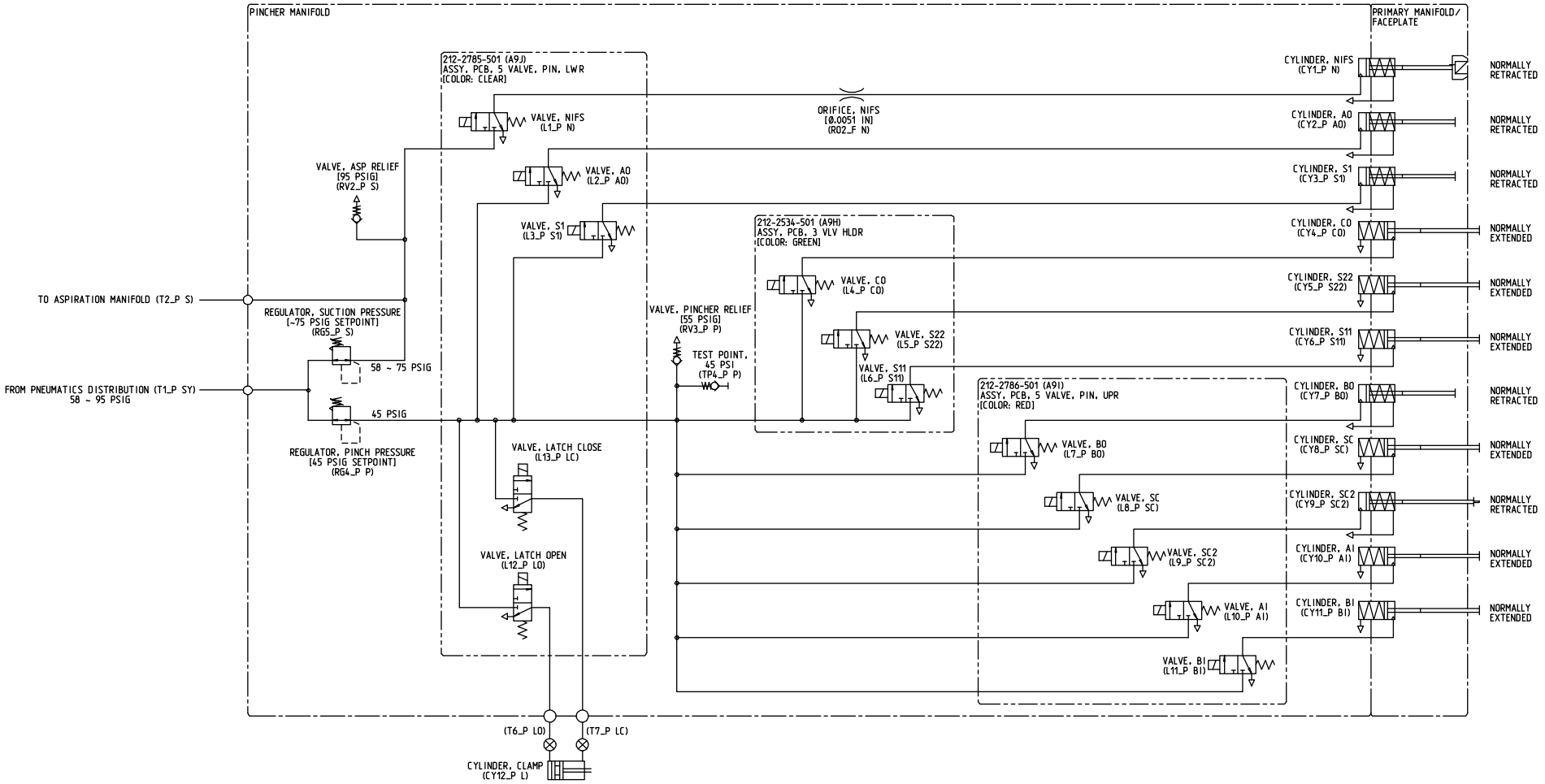


INFUSION CIRCUIT

212-1445-801 Fluidics Diagram (3 of 5)



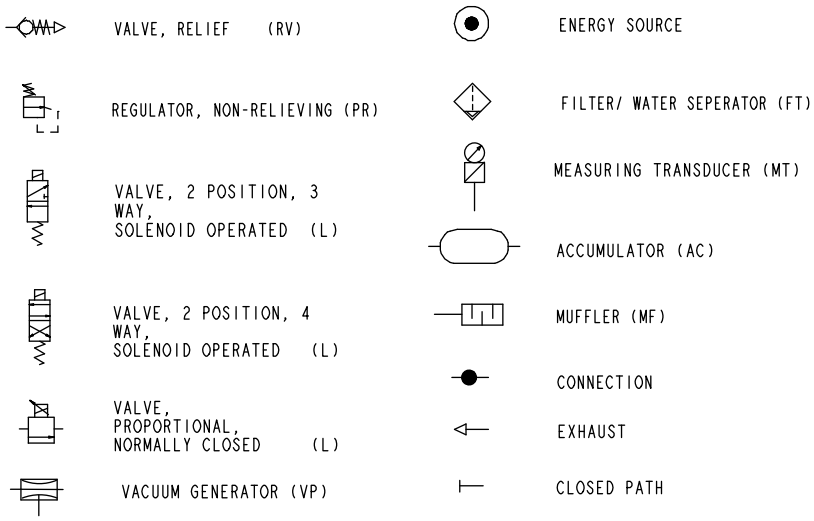
ASPIRATION CIRCUIT

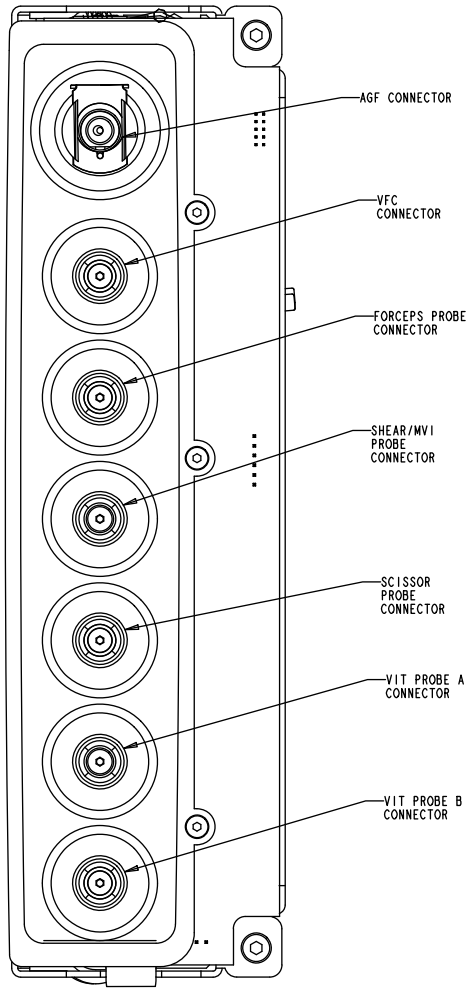


PINCHER CIRCUIT

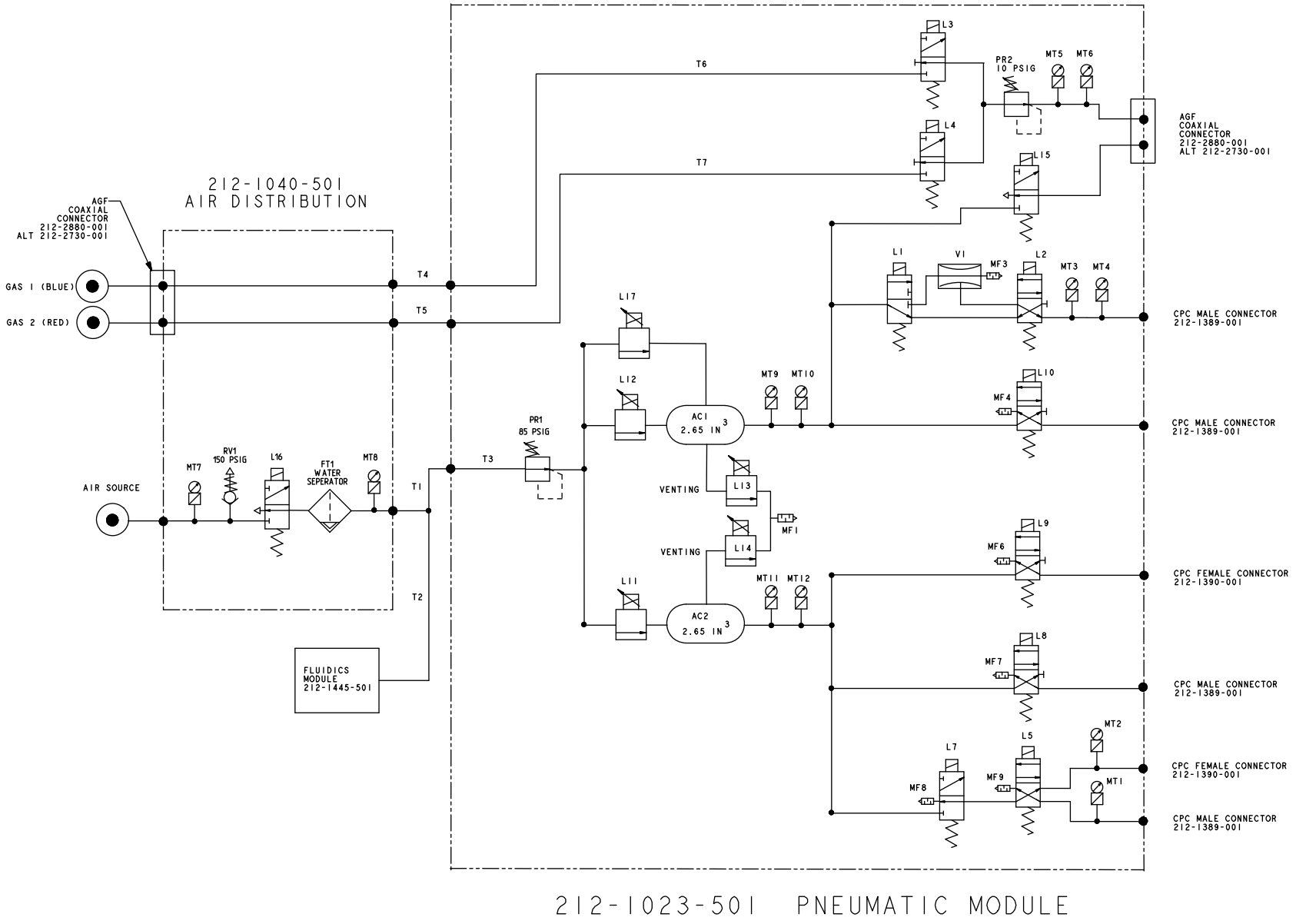
212-1445-801 **Fluidics Diagram (5 of 5)**

COMPONENT TYPE	QTY USED
AC = ACCUMULATOR	2
L = SOLENOID VALVE	16
MF = MUFFLER	9
MT = MEASURING TRANSDUCER	12
PR = PRESSURE REGULATOR	2
RV = RELIEF VALVE	1
T = TUBING	7
FT = FILTER	1
VP = VACUUM PUMP	1



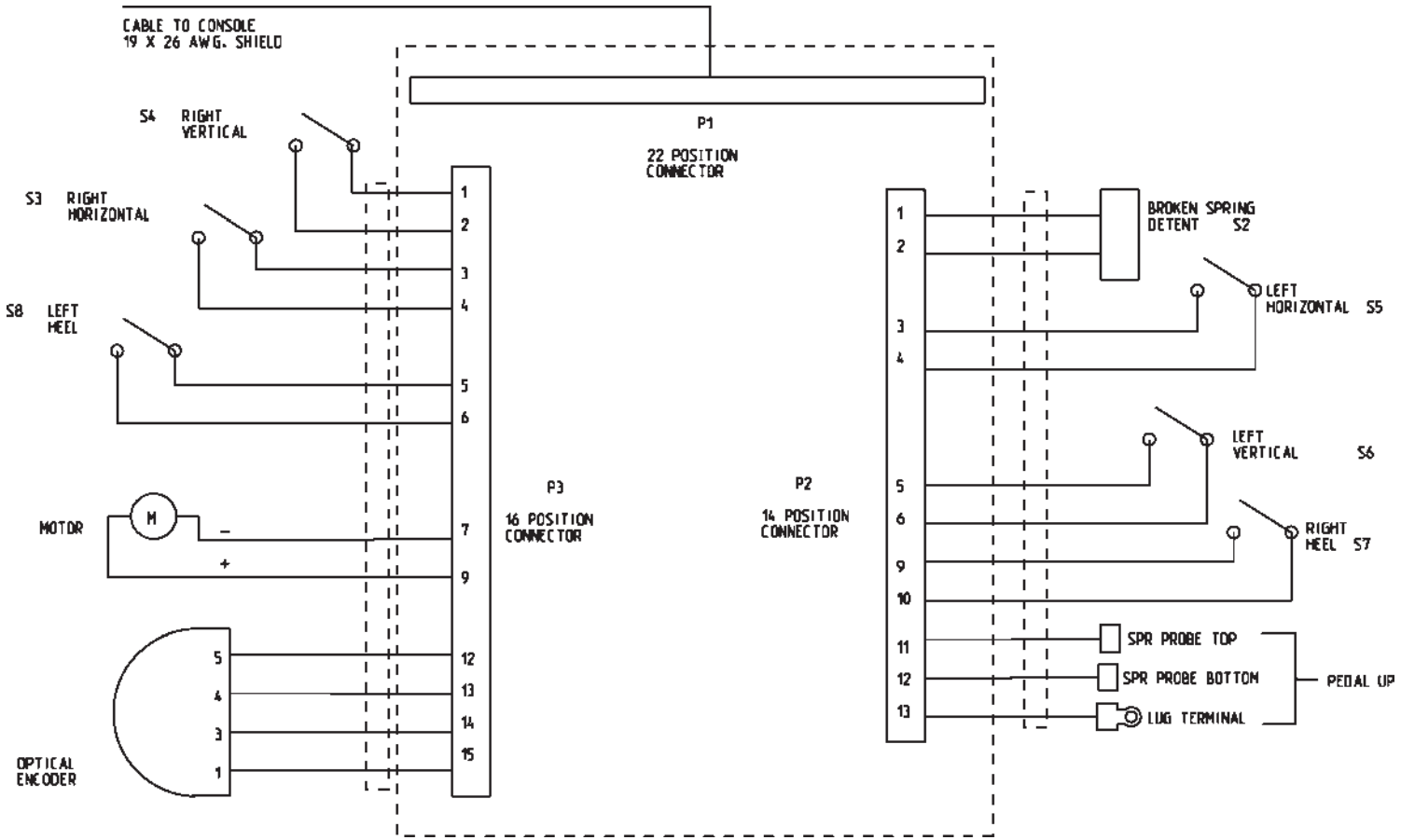


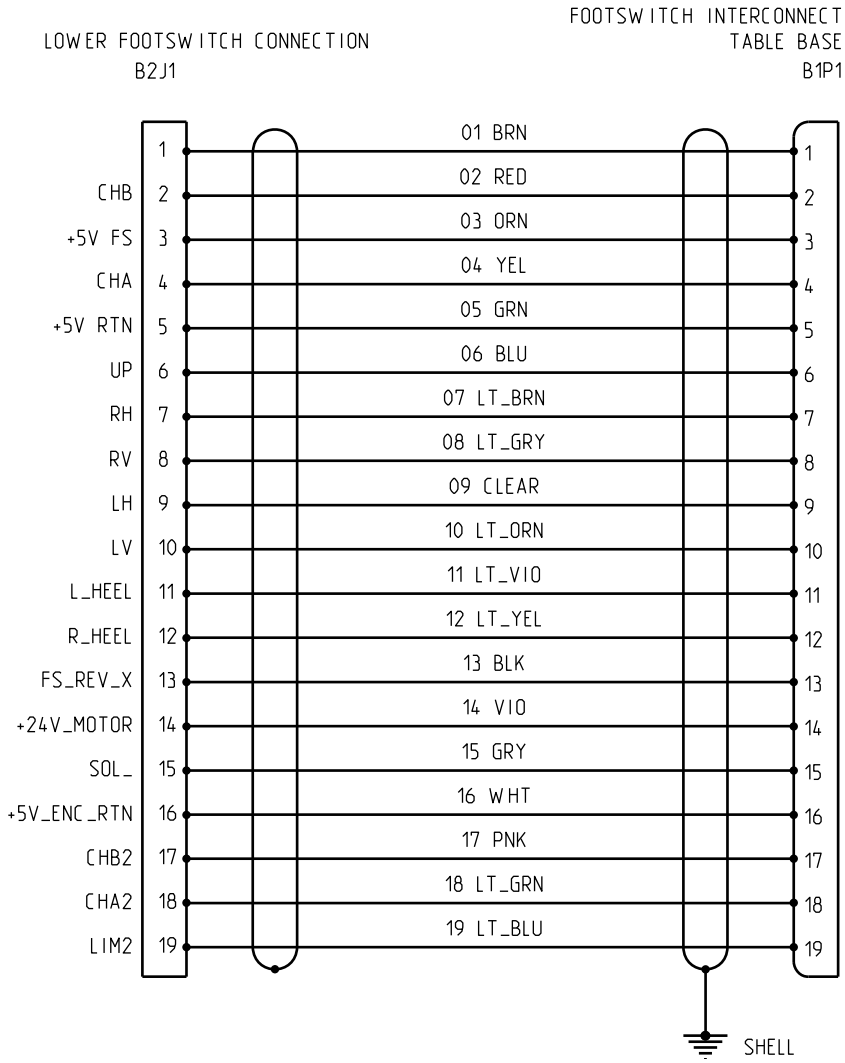
212-1023-801 Pneumatics Diagram (1 of 2)



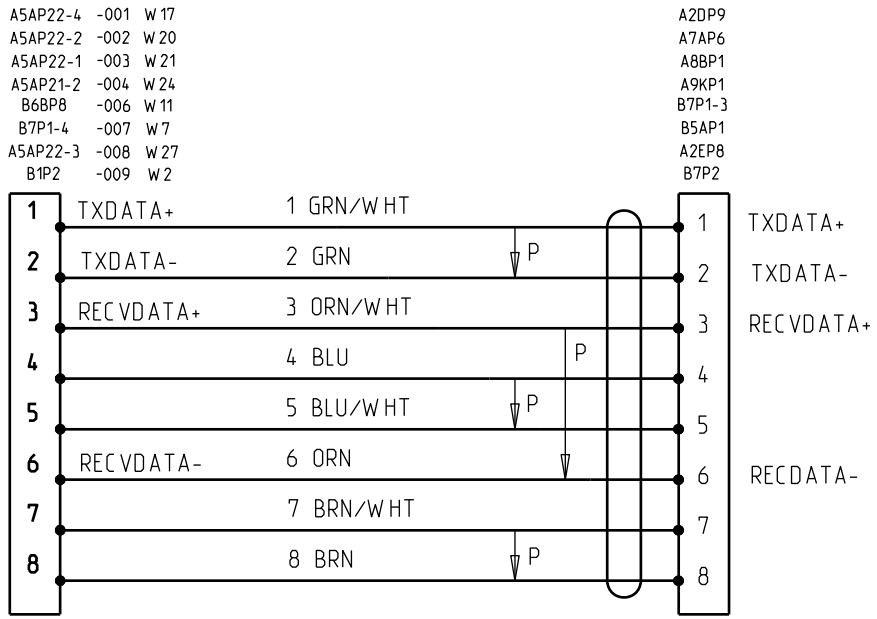
212-1023-501 PNEUMATIC MODULE

212-1023-801 Pneumatics Diagram (2 of 2)

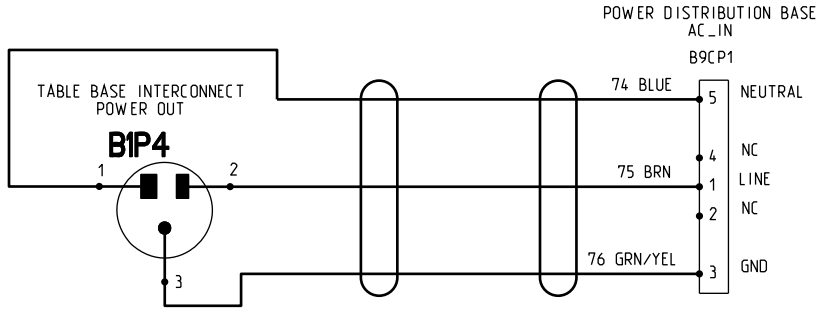

CABLE TO CONSOLE
19 X 26 AWG. SHIELD
P1
22 POSITION
CONNECTOR
S4 RIGHT
VERTICAL
S3 RIGHT
HORIZONTAL
S8 LEFT
HEEL
MOTOR
M
–
+
P3
16 POSITION
CONNECTOR
OPTICAL
ENCODER
P2
14 POSITION
CONNECTOR
BROKEN SPRING
DETENT S2
LEFT
HORIZONTAL S5
LEFT
VERTICAL S6
RIGHT
HEEL S7
SPR PROBE TOP
SPR PROBE BOTTOM
LUG TERMINAL
PEDAL UP



W01 - Base 212-1678-001 Cable, Footswitch

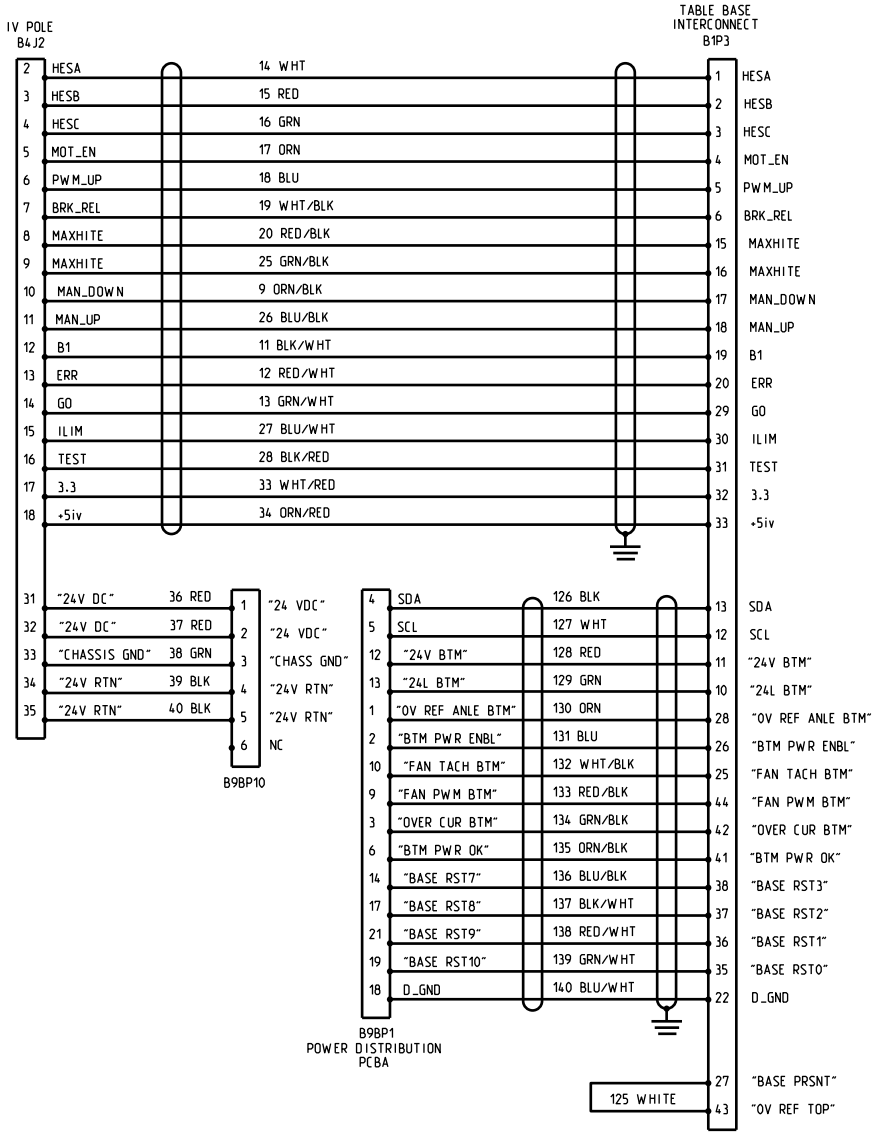


W17, 20, 21, 24, 27 - Console 212-1560-xxx Cable, Ethernet
W02, 07, 11 - Base

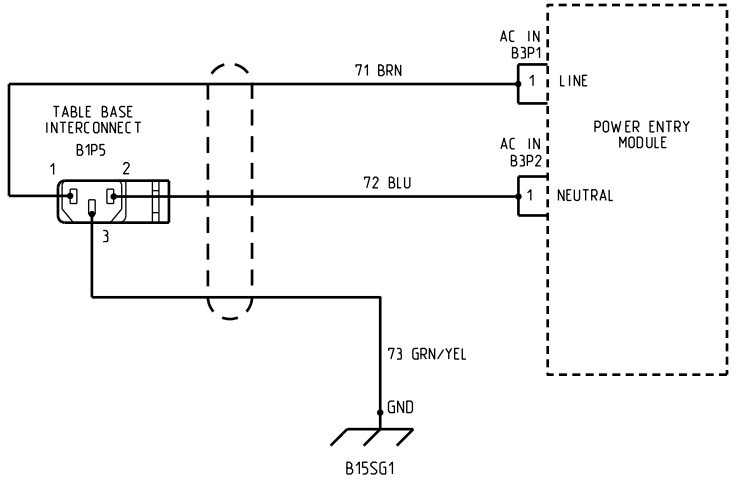


W04 - Base 212-1681-001 Cable, Power Out

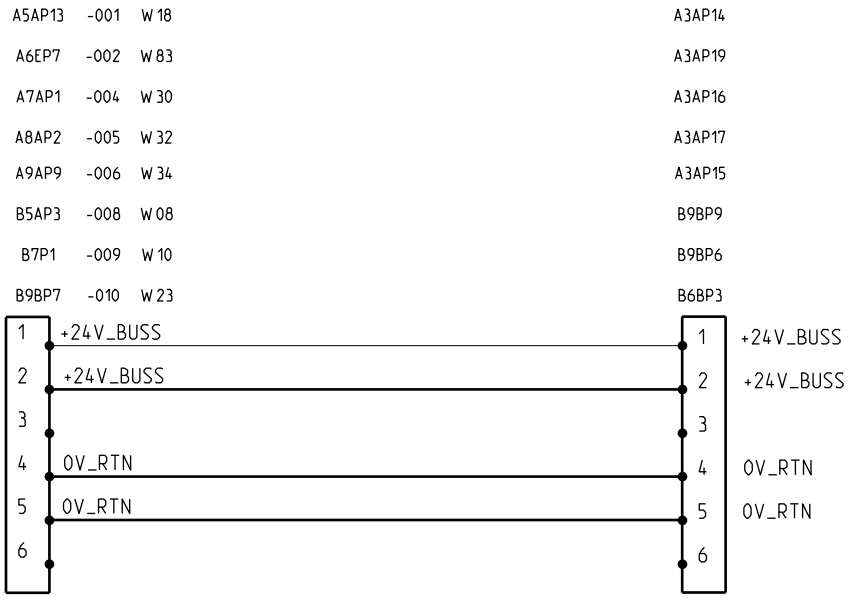
Cables, Interconnect, Constellation Vision System



W03 - Base 212-1680-001 Cable, Data IO

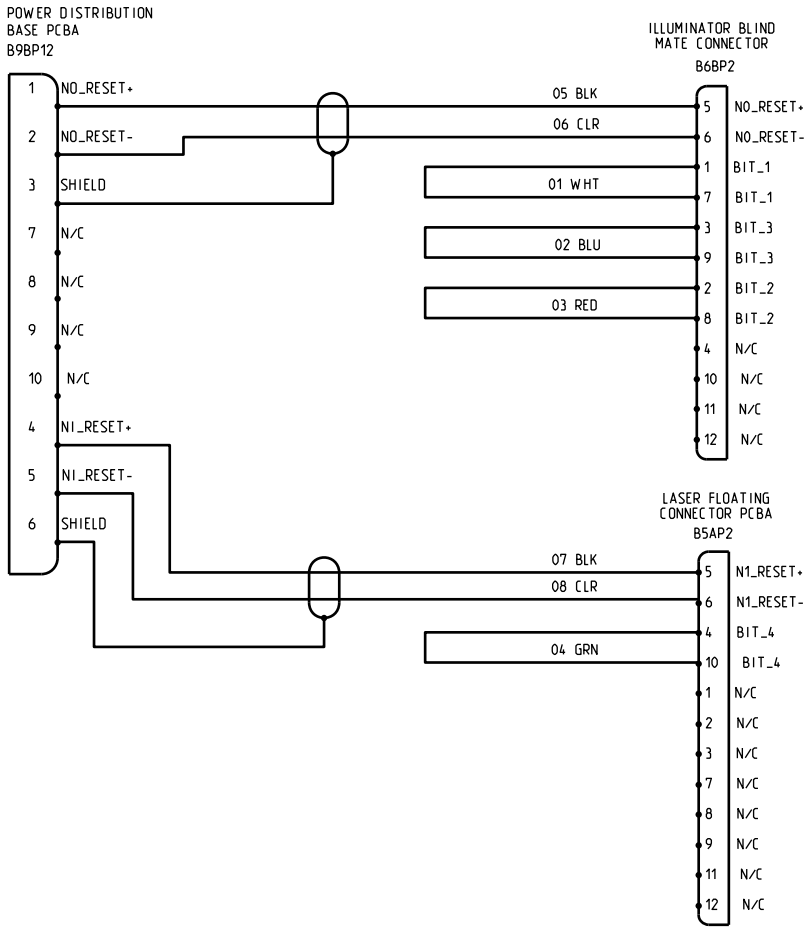


W05 - Base 212-2201-001 Cable, AC Power In

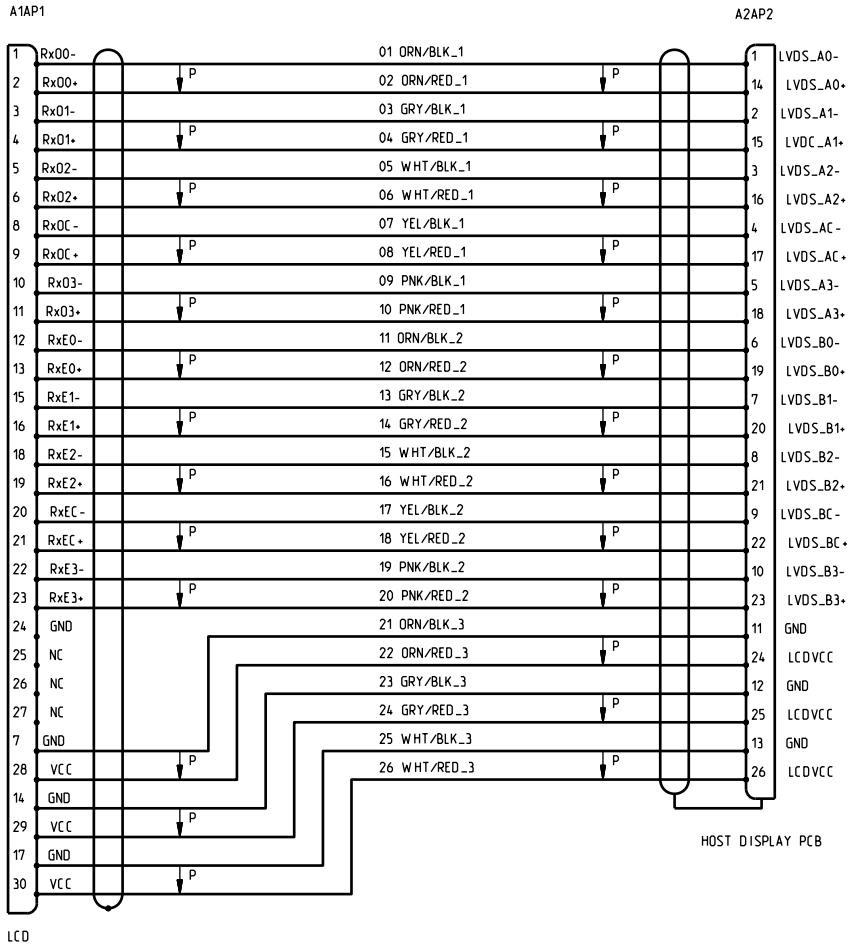


W18, 30, 32, 34, 83 - Console 212-1561-xxx Cable, 24V DC
W08, 10, 23 - Base

Cables, Interconnect, Constellation Vision System

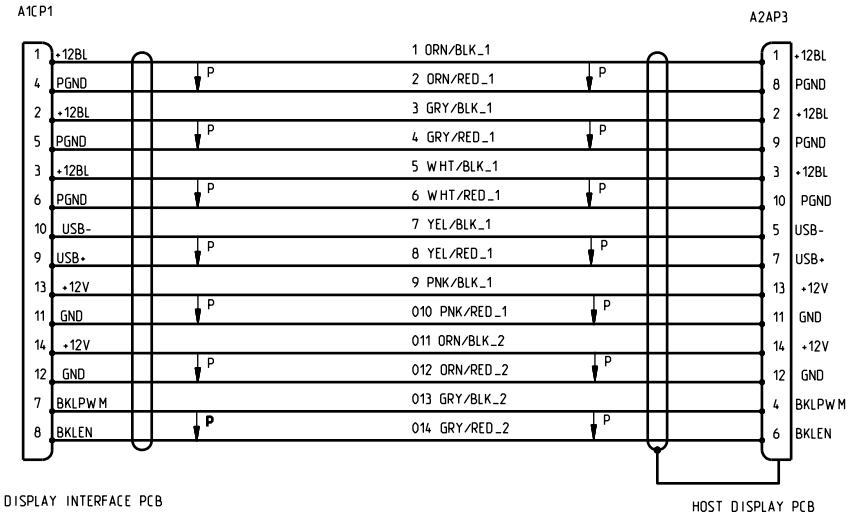


W09 - Base 212-1689-001 Cable, Slot ID

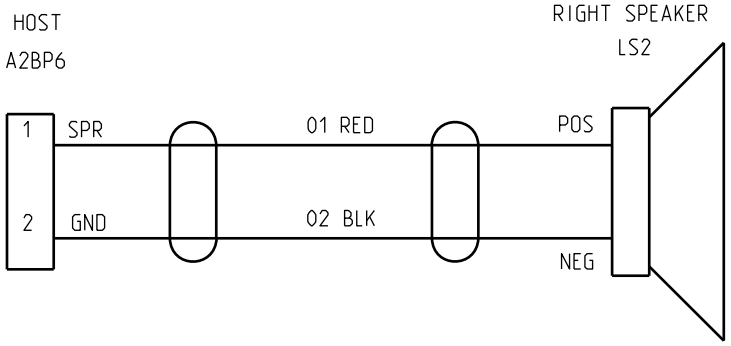


W12 - Console 212-1871-001 Cable, Video, LVDS

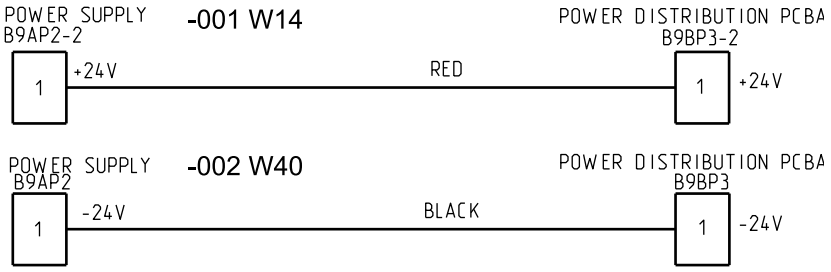
W12 - Base 212-2019-001 Cable, Ground Equi



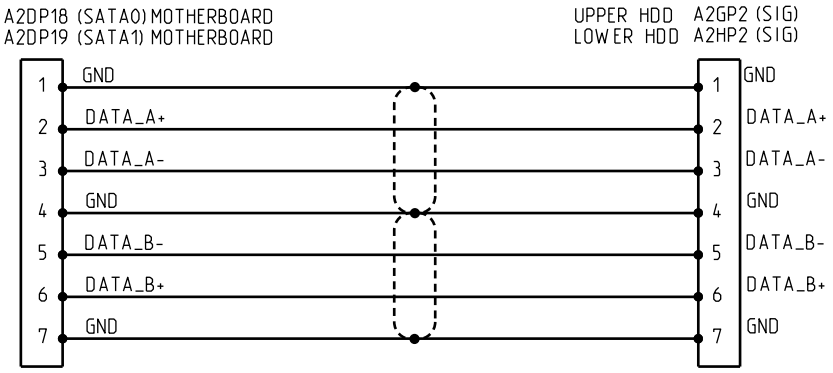
W13 - Console 212-1872-001 Cable, Interface, Display



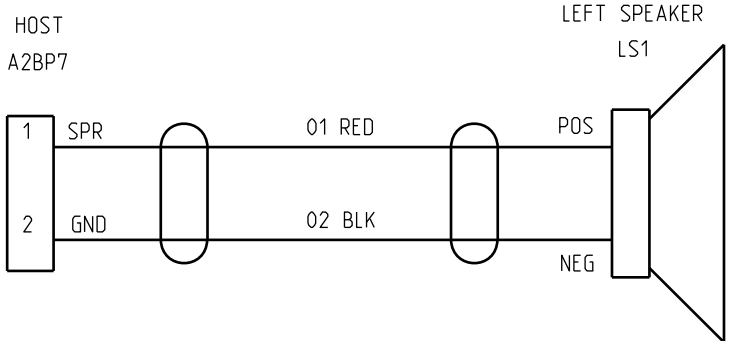
W14 - Console 212-1557-001 Cable, Speaker, Right



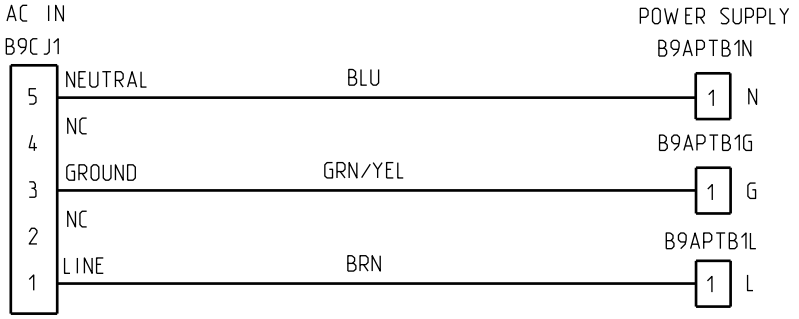
W14, 40 - Base 212-2220-xxx Cable, DC Power



W61, 62 - Console 212-2383-001 Cable, SATA SIG

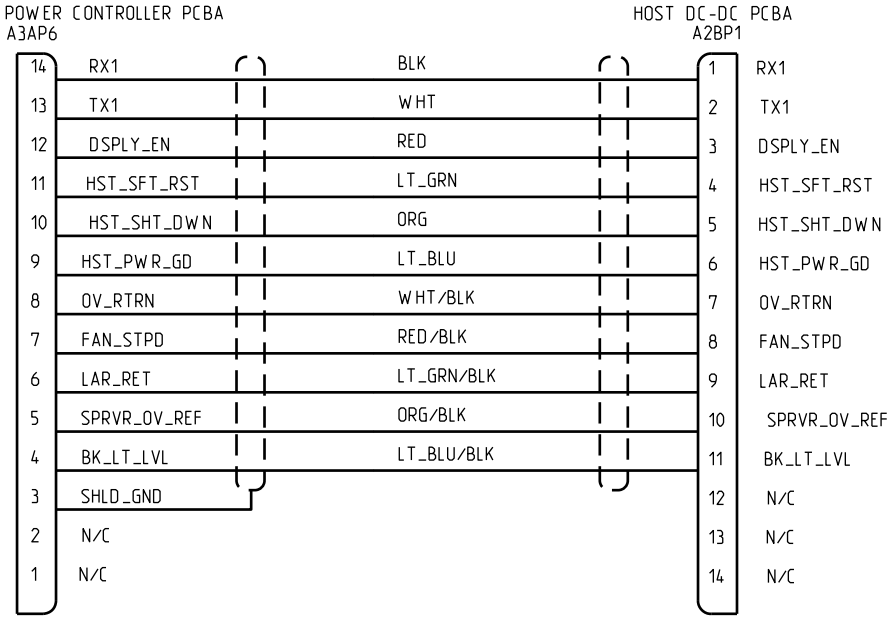


W15 - Console 212-1557-002 Cable, Speaker, Left

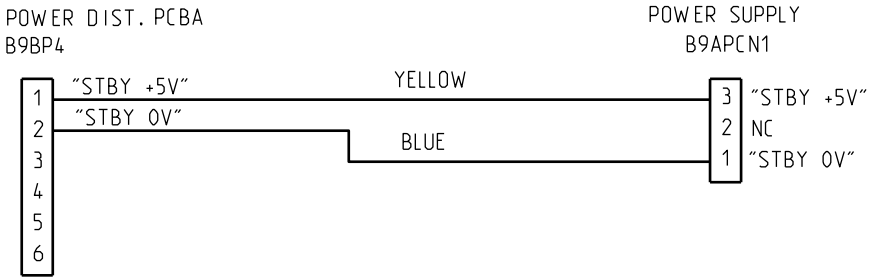


W15 - Base 212-2221-001 Cable, AC In

Cables, Interconnect, Constellation Vision System

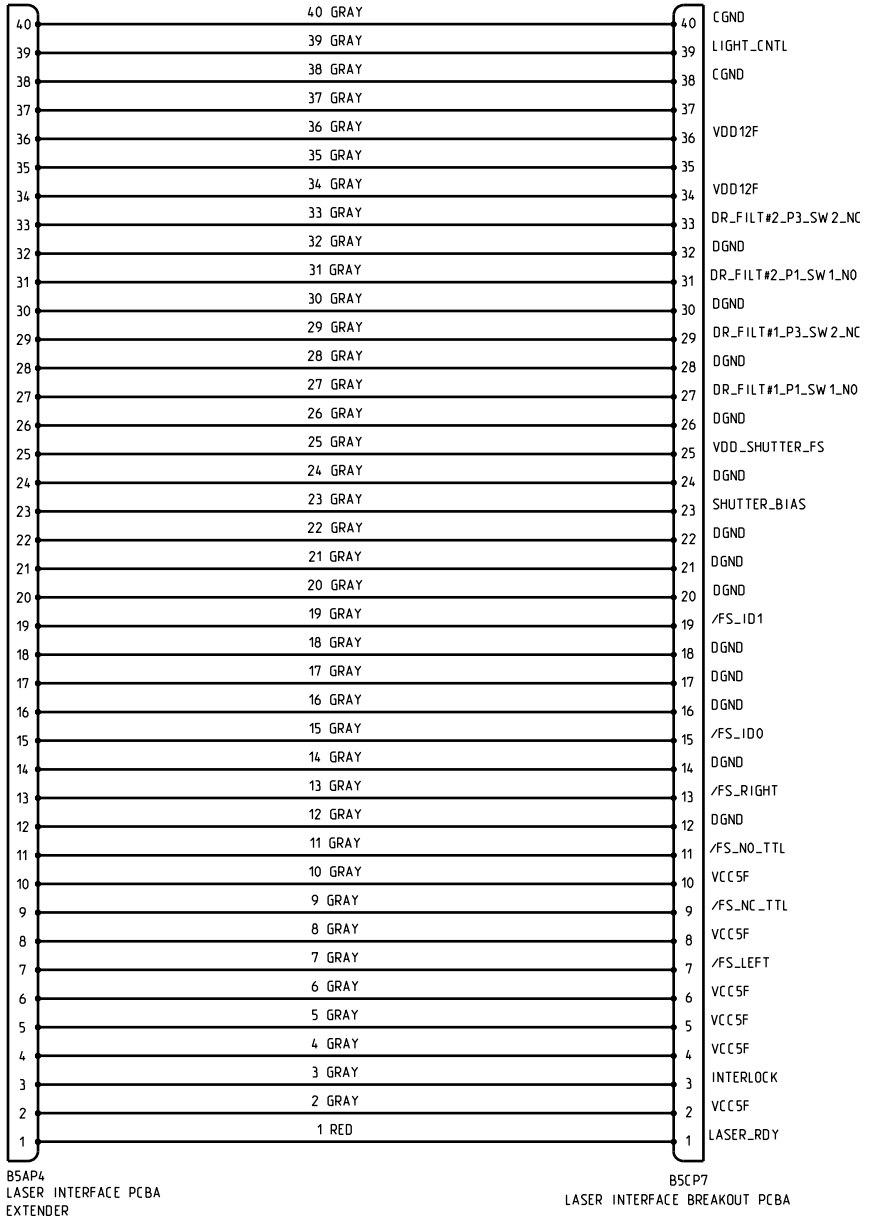


W16 - Console 212-1559-001 Cable, Host Interface



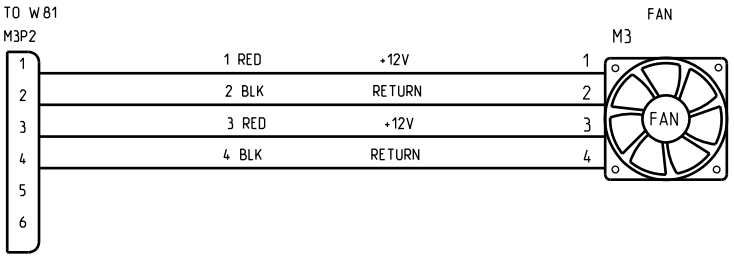
W16 - Base 212-2222-001 Cable, PS Control

W120, 121 - Console 212-2223-XXX Cable, Ground
W17, 36 - Base

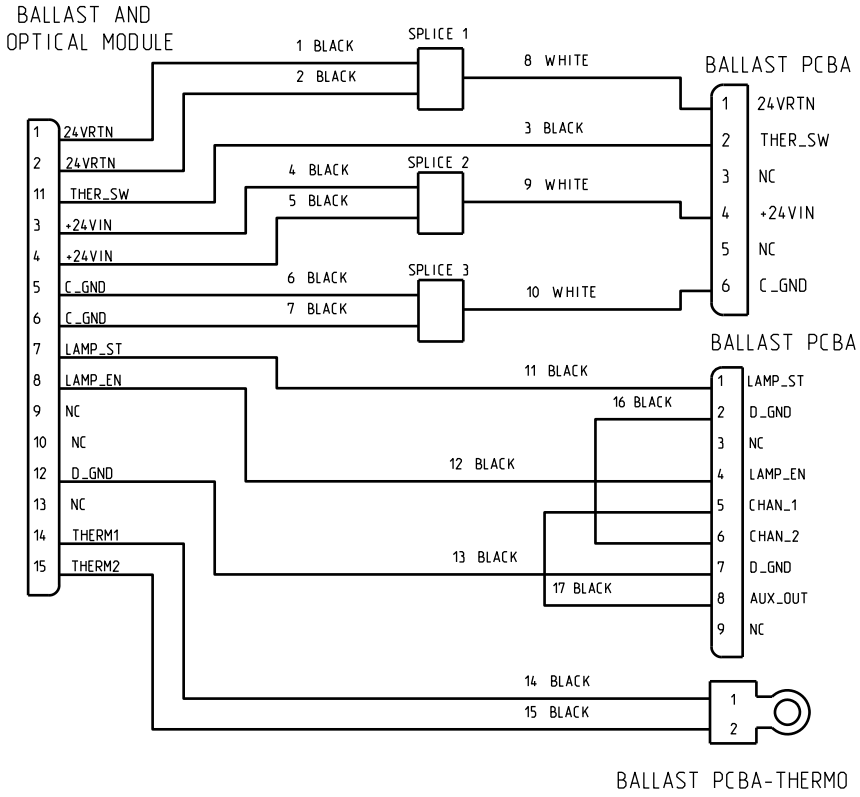


W19 - Base 212-1996-001 Cable, Laser Interface

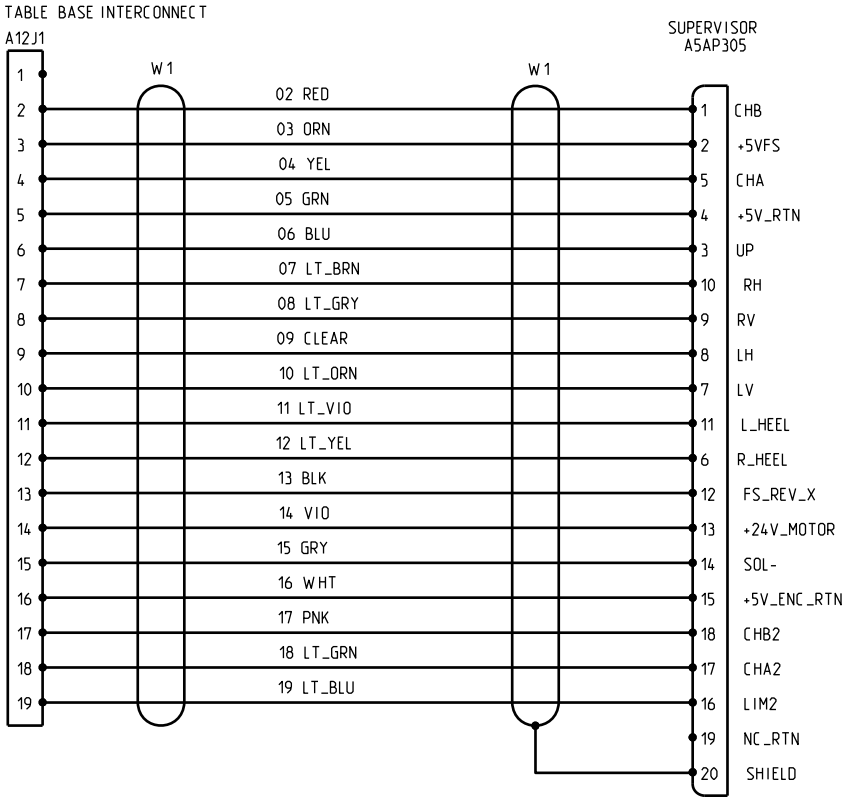
Cables, Interconnect, Constellation Vision System



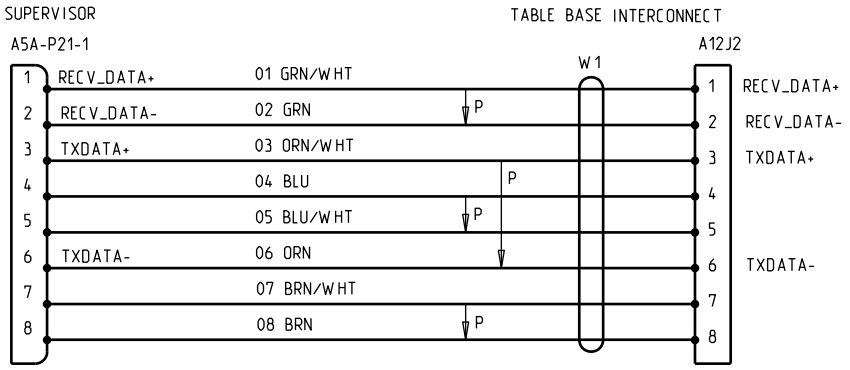
W29 - Console 212-2268-002 Cable, Fan
W20 - Base



W117 - Console 212-2655-001 Cable, Ballast Interface
W21 - Base

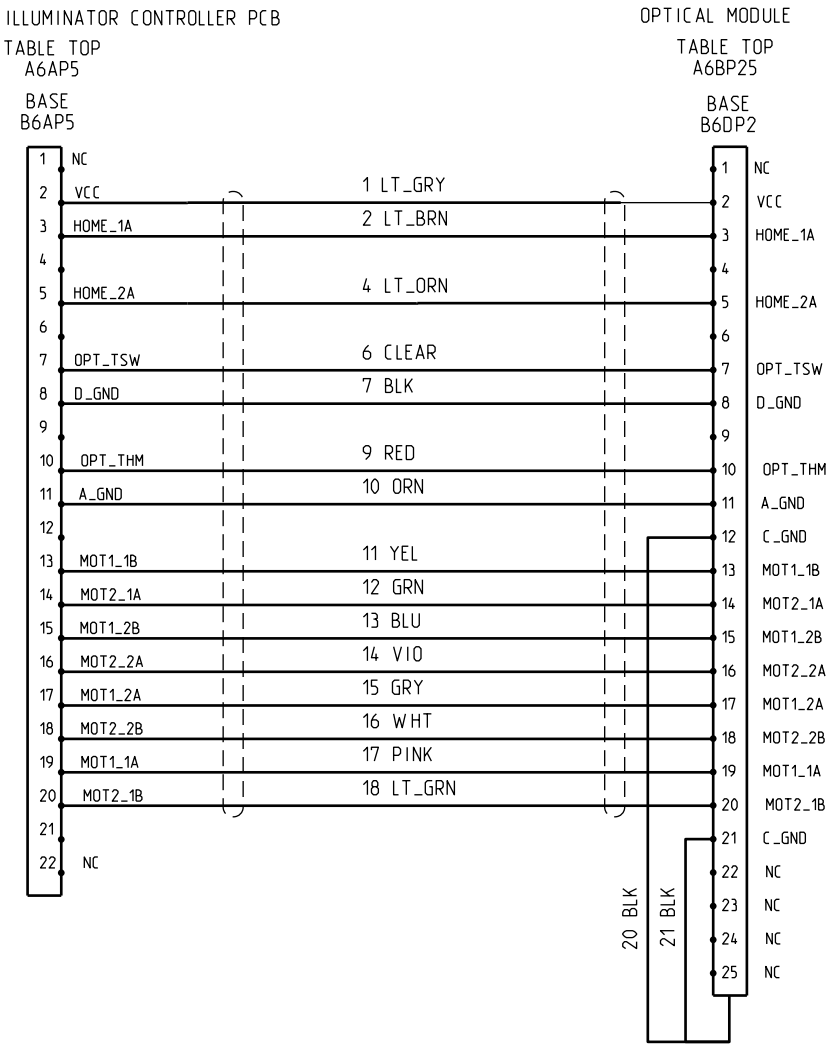


W22 - Console 212-1565-001 Cable, Footswitch

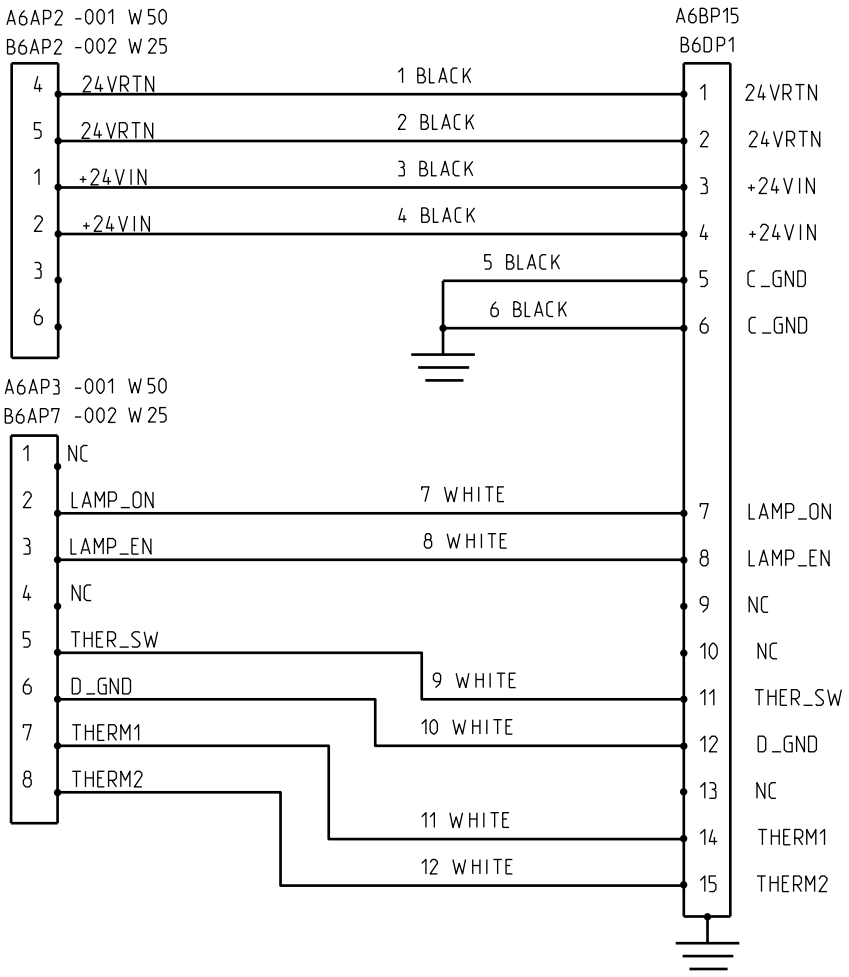


W23 - Console 212-1566-001 Cable, Ethernet to Base

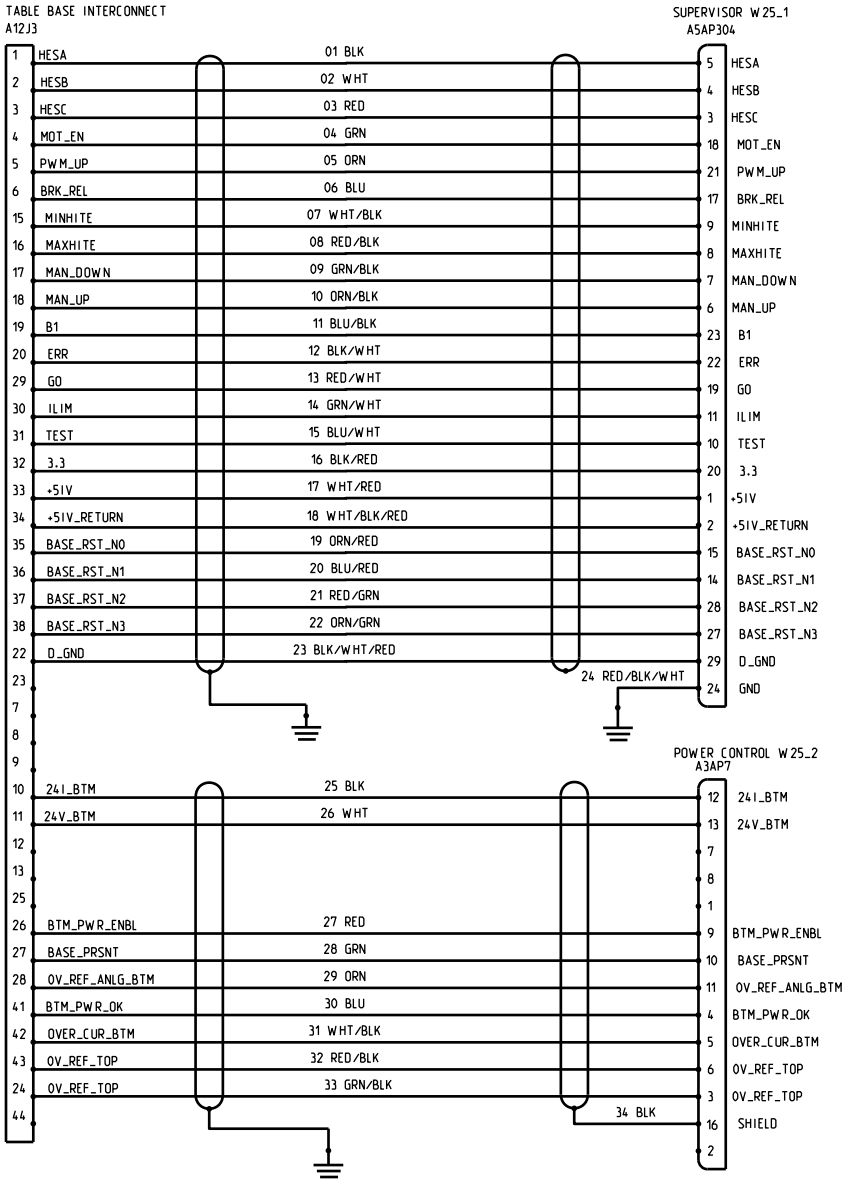
Cables, Interconnect, Constellation Vision System



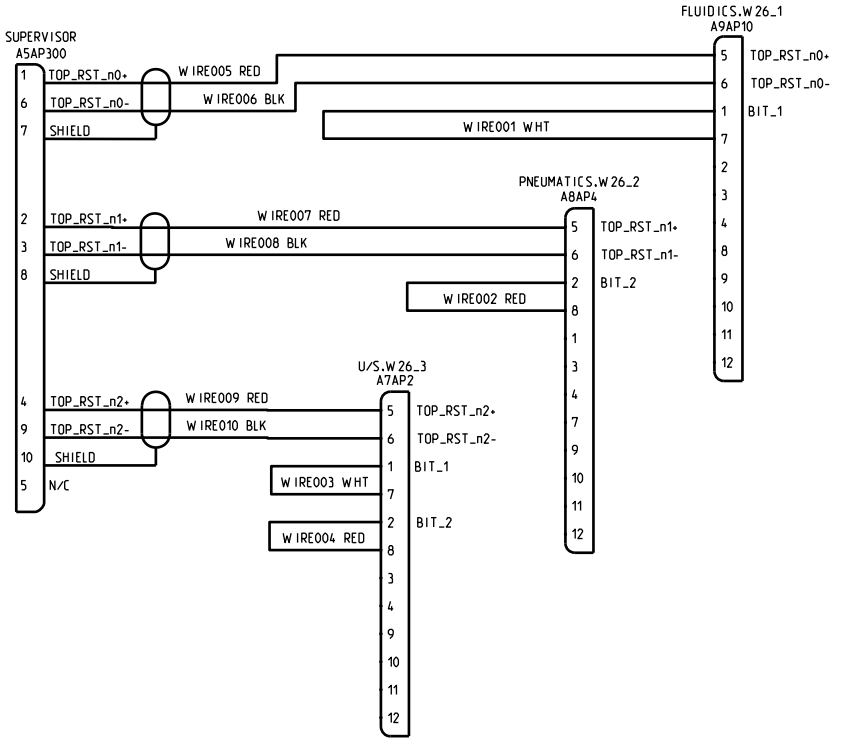
W51 - Console 212-2196-001 Cable, Illum Opt Intfc
W24 - Base



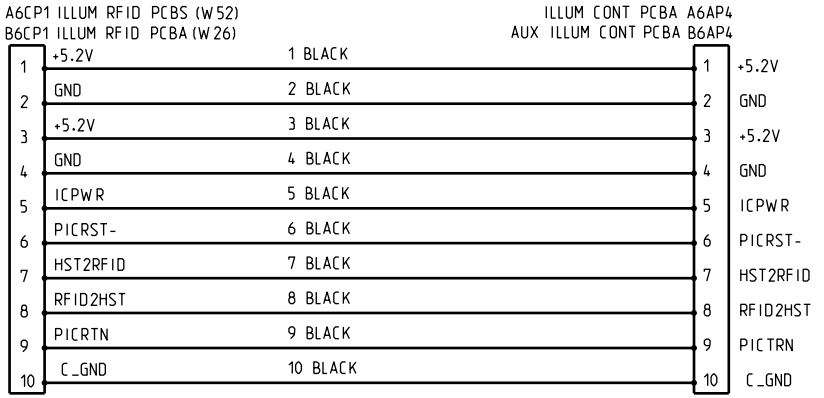
W50 - Console 212-2198-XXX Cable, Ballast Interface
W25 - Base



W25 - Console 212-1568-001 Cable, Data IO



W26 - Console 212-1569-001 Cable, Slot ID

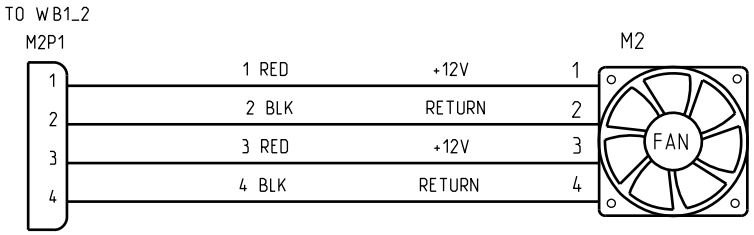


W52 - Console 212-2199-001 Cable, Illum RF ID INTFC
W26 - Base

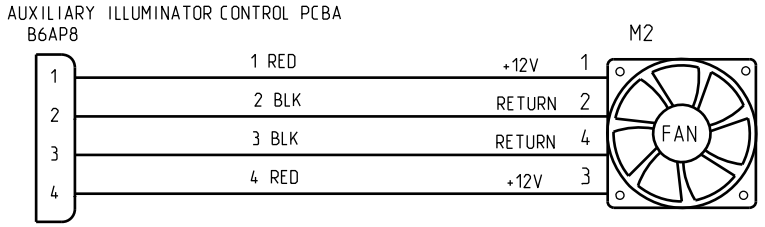
Cables, Interconnect, Constellation Vision System

REFERENCE DESIGNATOR		
PIN TO PIN		
B6D3J5	B6DJ7	
1	14	MOTOUT2_1A
2	2	+5V
3	15	MOTOUT1_2B
4	3	HOMESEN1A_IN
5	16	MOTOUT2_2A
6	4	HOMESEN1B_IN
7	17	MOTOUT1_2A
8	5	HOMESEN2A_IN
9	18	MOTOUT2_2B
10	6	HOMESEN2B_IN
11	19	MOTOUT1_1A
12	7	OPT_THERMALSW
13	20	MOTOUT2_1B
14	8	DGND
15	21	CGND [5]
16, 17	22	CGND
18	10	OPT_TEMP
19	11	AGND
20	12	CGND [5]
21	25	CGND
22	13	MOTOUT1_1B
NC	23	
NC	24	
NC	1	
NC	9	

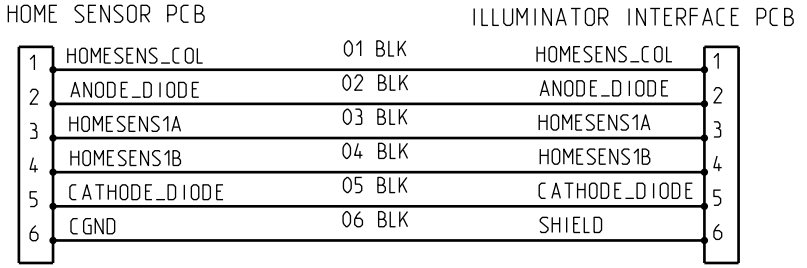
W27 - Base 212-2657-001 Cable, Flex Aux Illum



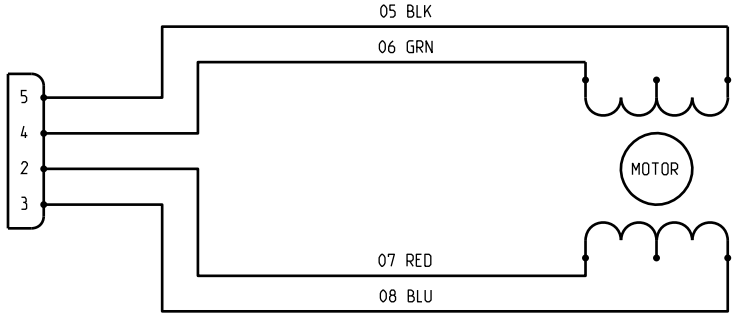
W28 - Console 212-2267-002 Cable, Fan



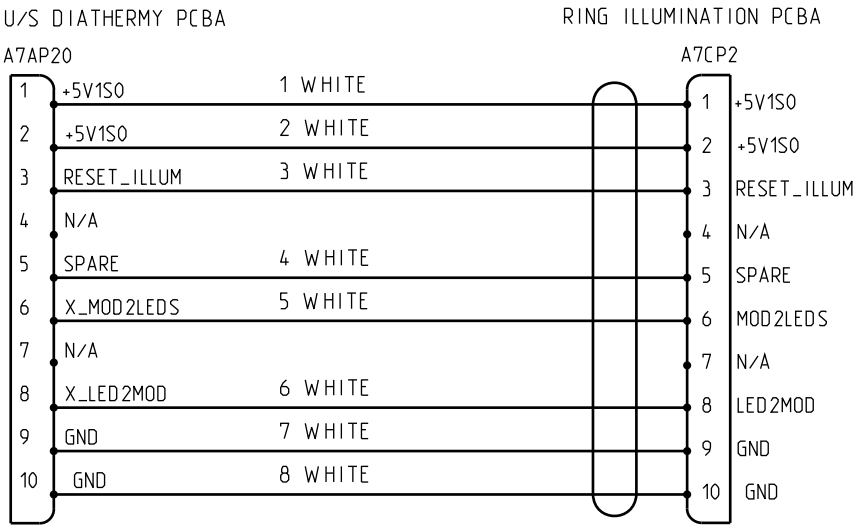
W33 - Base 212-2267-003 Cable, Fan Ballast



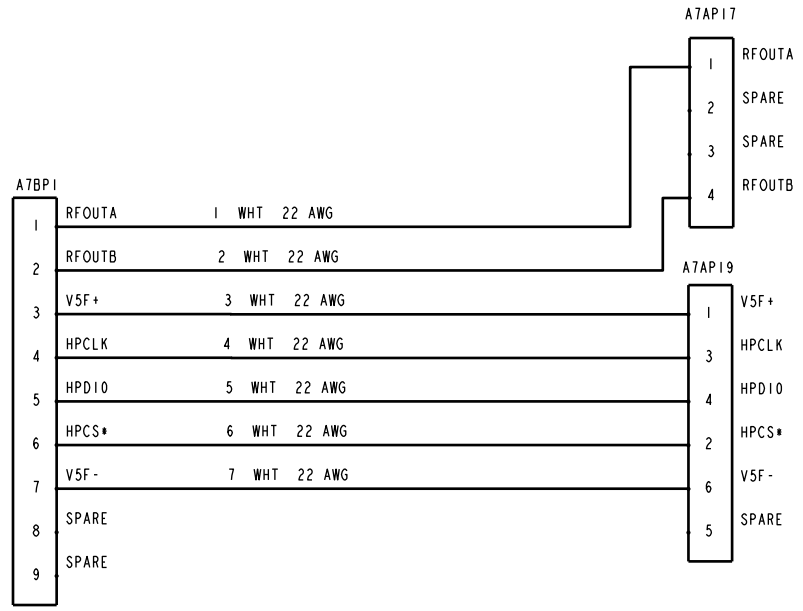
W115, 116 - Console 212-2658-001 Cable, Home Pos Sensor
W28, 29 - Base



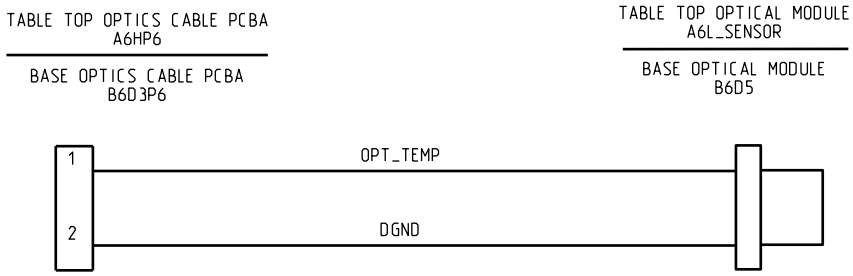
W113, 114 - Console 212-2658-001 Cable, Stepper Motor
W30, 31 - Base



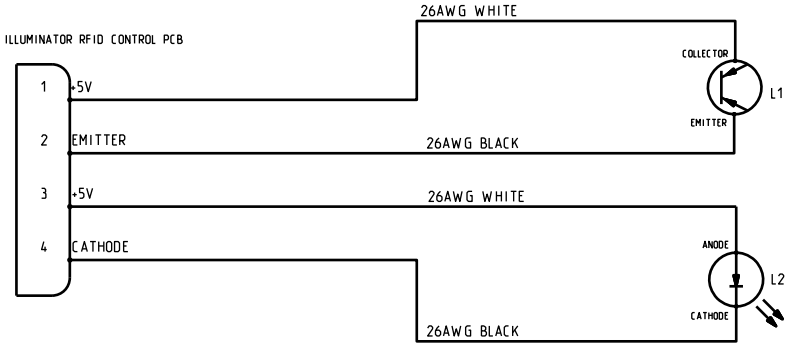
W31 - Console 212-2269-001 Cable, U/S Ring Illlum



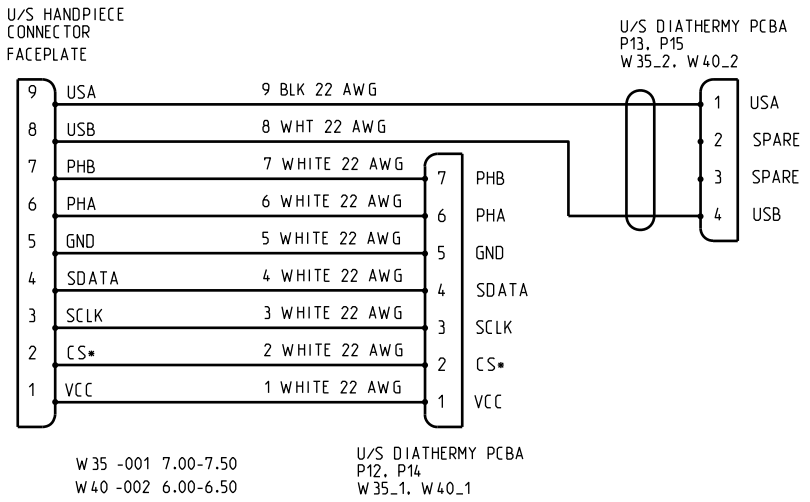
W33 - Console 212-2270-001 Cable, Aqua



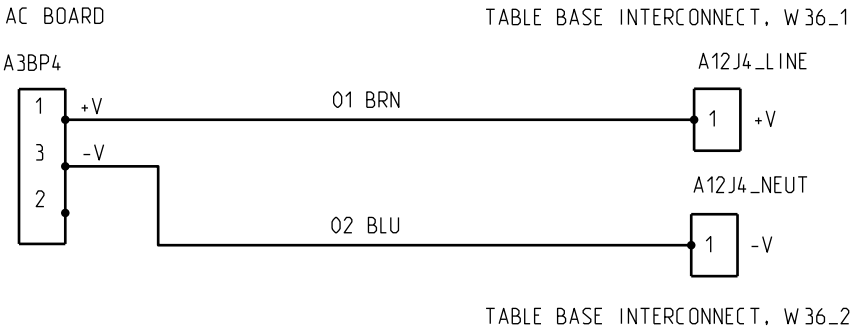
W102 - Console 212-2623-001 Cable, Thermistor, Illum
W32 - Base



W118, 119 - Console 212-2266-001 Cable, Fiber Detect
W34, 35 - Base

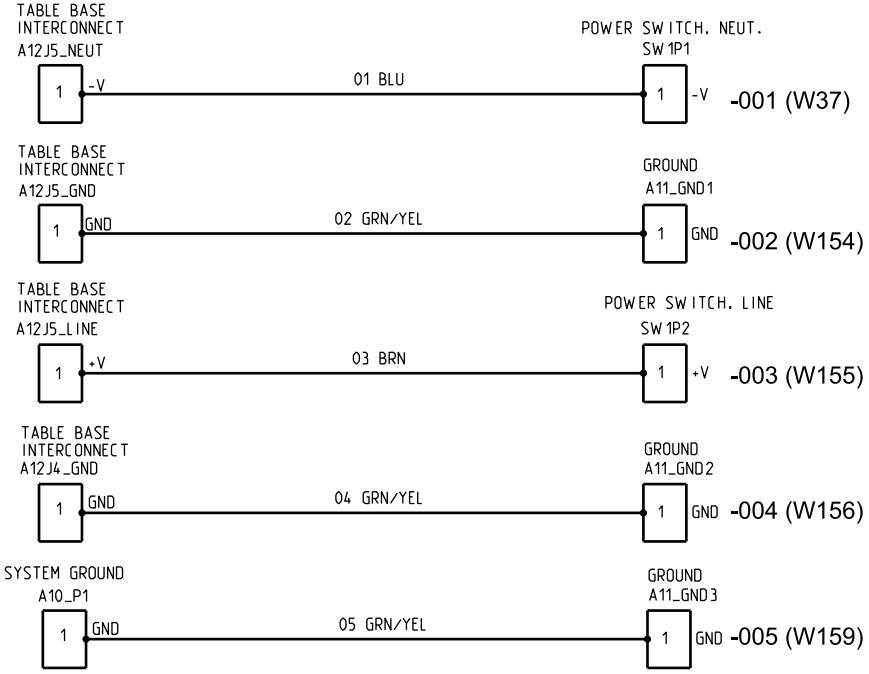


W35, 40 - Console 212-2271-001 Cable, U/S

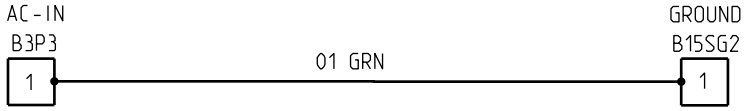


W36 - Console 212-1579-001 Cable, AC Output

W39 - Console 212-2332-001 Cable, Host Fan



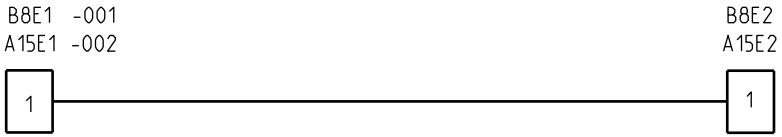
W37,154,155,156,159 - Console 212-1580-XXX Cable, AC Output



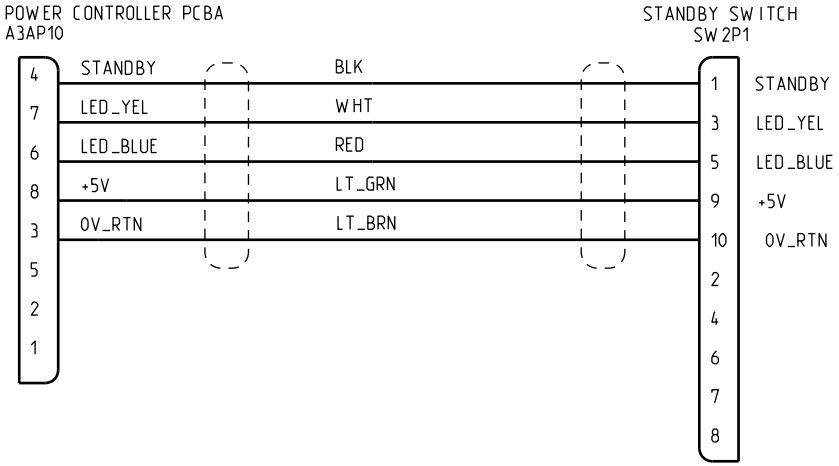
W37 - Base 212-2832-001 Cable, Ground

W38 - Base 212-2833-001 Cable, Ground

Cables, Interconnect, Constellation Vision System

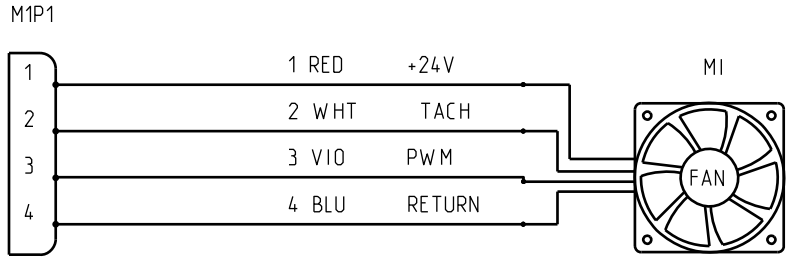


W150 - Console 212-2957-XXX Cable, Gnd, Illum Ejctr
W39 - Base

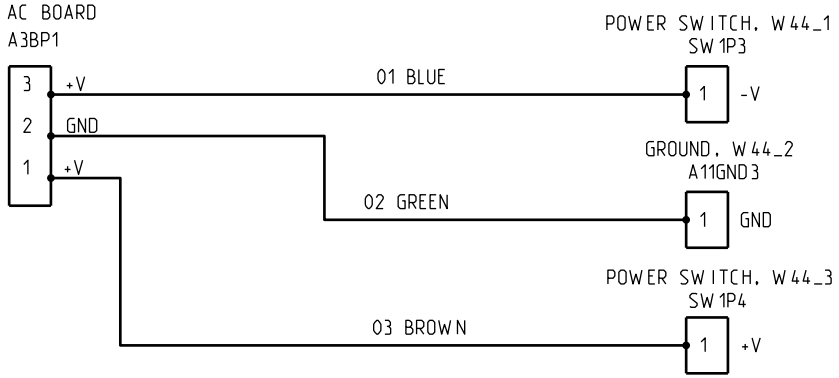


W41 - Console 212-1584-001 Cable, Standy Sw

W42 - Console 212-2273-001 Cable, Diathermy

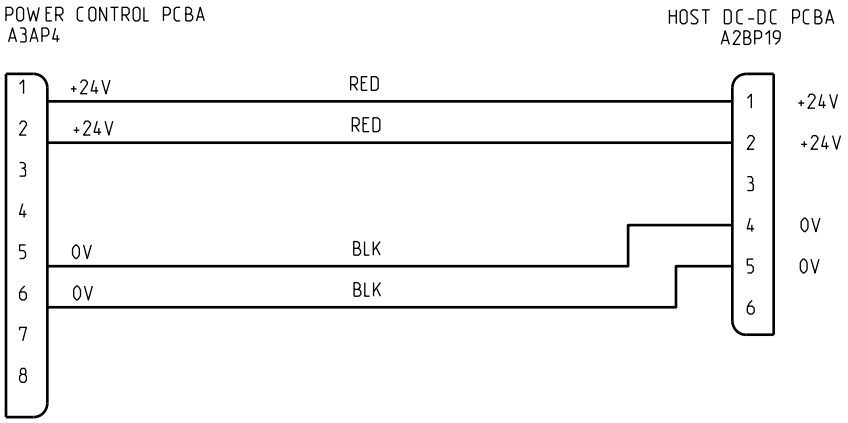


W43 - Console 212-1586-001 Cable, Fan

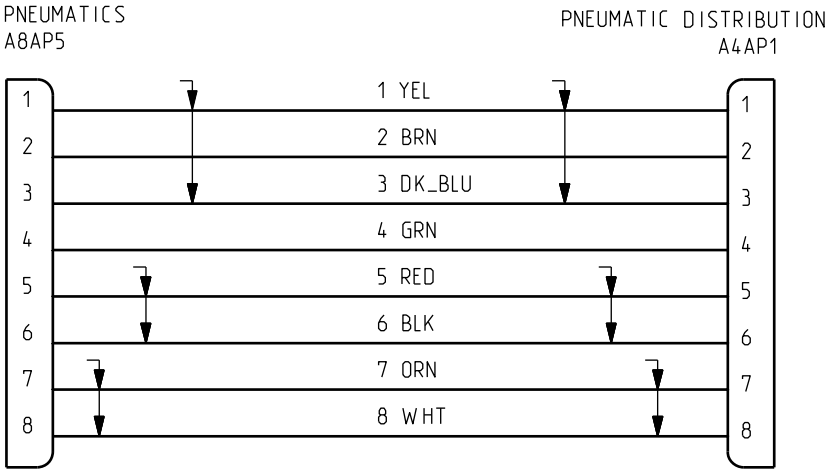


W44 - Console 212-1587-001 Cable, AC In Breaker

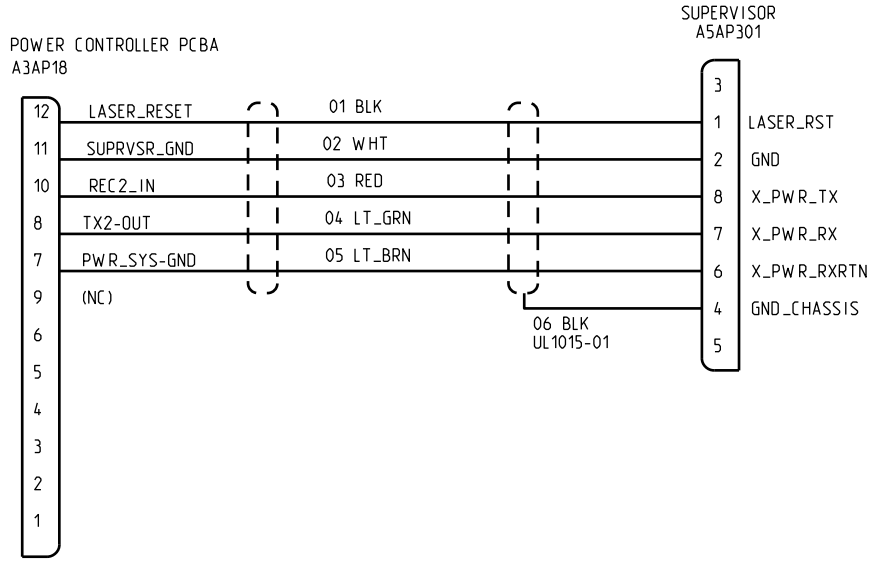
W45, 153 - Console 212-2274-XXX Cable, Fan



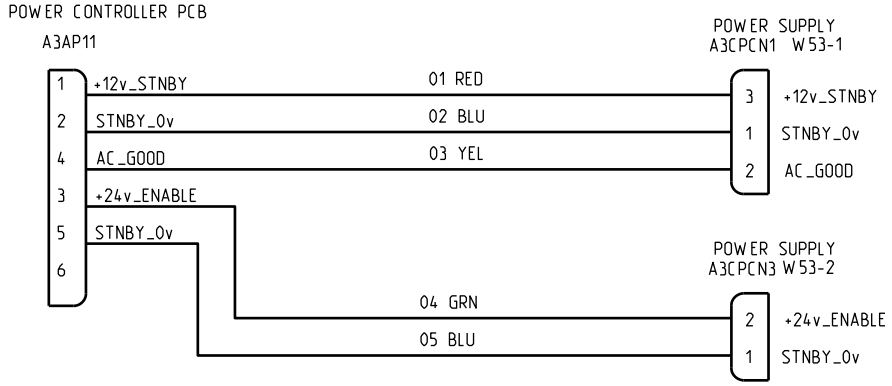
W46 - Console 212-1589-001 Cable, 24 VDC



W47 - Console 212-2062-001 Cable, Pneu Dist



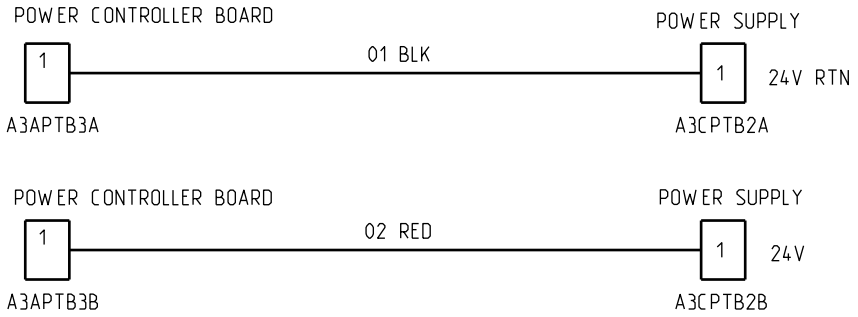
W48 - Console 212-2063-001 Cable, Supervisor Inf



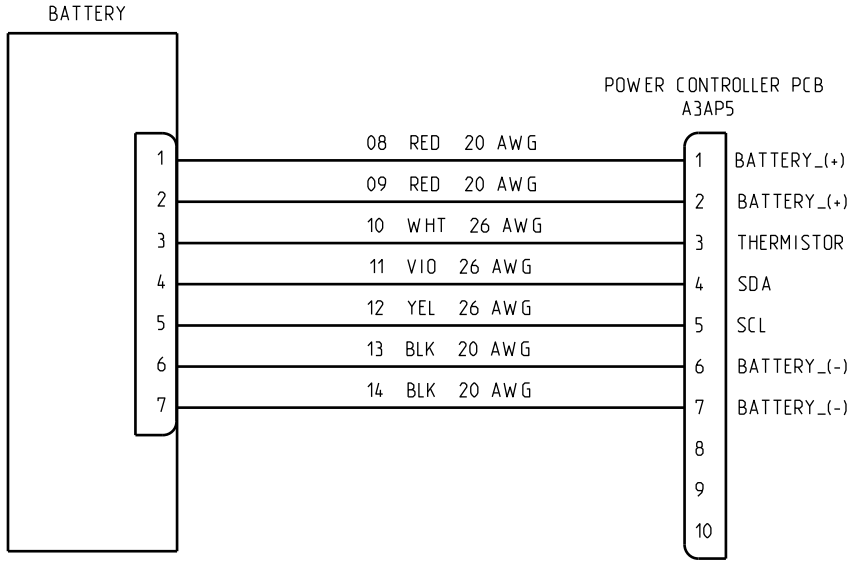
W53 - Console 212-2257-001 Cable, Pwr Sup Cntrl

REFERENCE DESIGNATOR		
PIN TO PIN		
A6HP5	A6BJ25	
1	14	MOTOUT2_1A
2	2	+5V
3	15	MOTOUT1_2B
4	3	HOMESEN1A_IN
5	16	MOTOUT2_2A
6	4	HOMESEN1B_IN
7	17	MOTOUT1_2A
8	5	HOMESEN2A_IN
9	18	MOTOUT2_2B
10	6	HOMESEN2B_IN
11	19	MOTOUT1_1A
12	7	OPT_THERMALSW
13	20	MOTOUT2_1B
14	8	DGND
15	21	CGND
16. 17	22	CGND
18	10	OPT_TEMP
19	11	AGND
20	12	CGND
21	25	CGND
22	13	MOTOUT1_1B
NC	23	
NC	24	
NC	1	
NC	9	

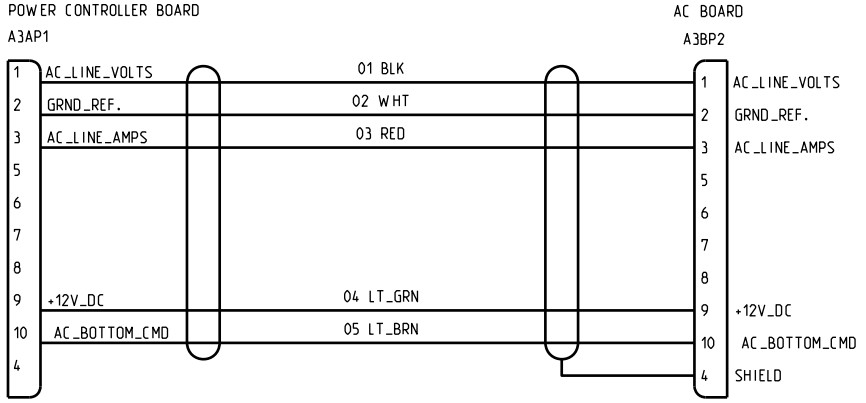
W49 - Console 212-2531-001 Cable, Circuit, Flex Illum



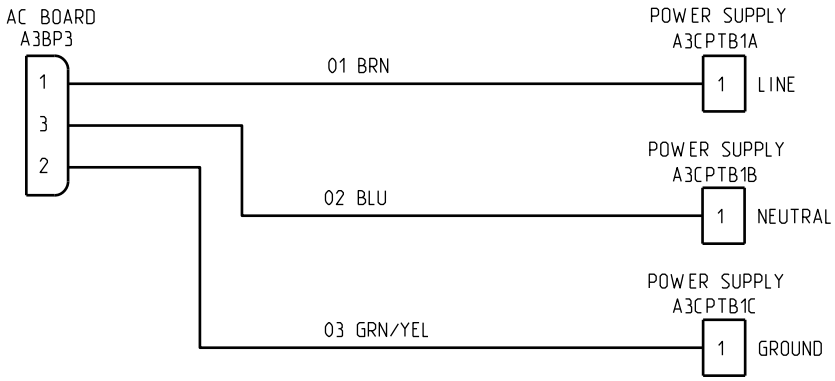
W54 - Console 212-2258-001 Cable, DC Power, Main



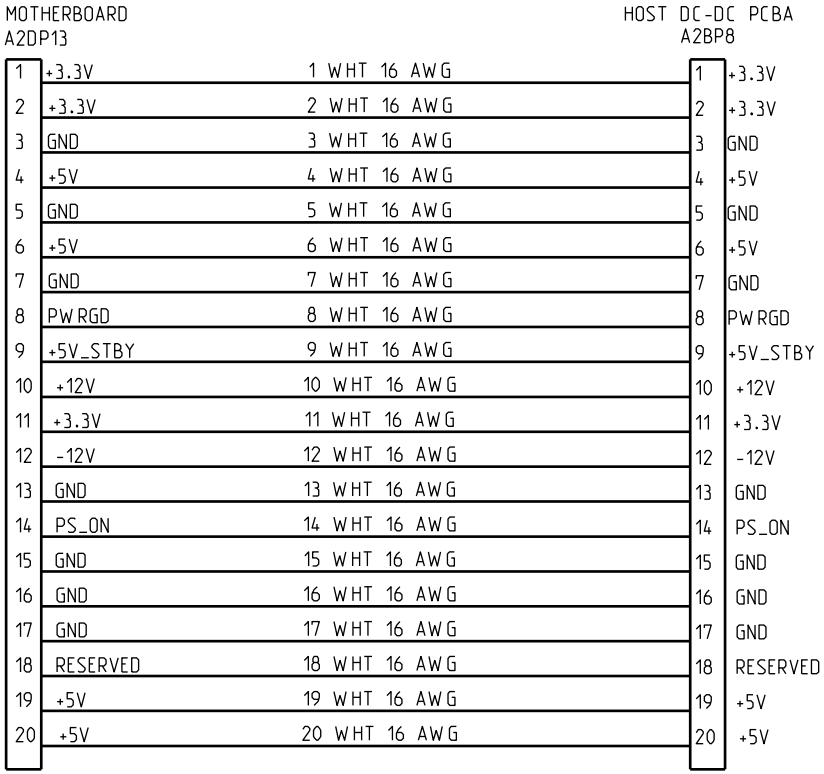
W55 - Console 212-2227-001 Battery, Power Module



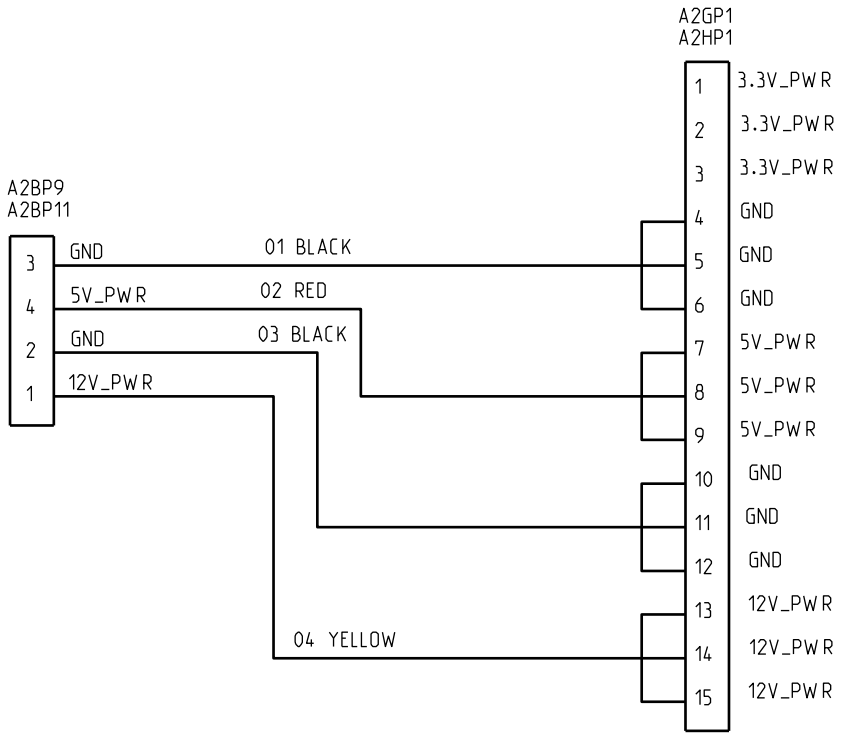
W56 - Console 212-2260-001 Cable, AC Control



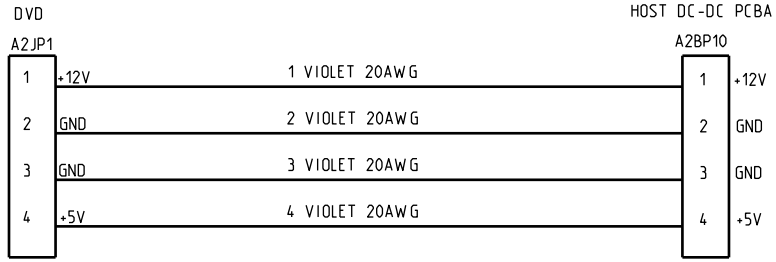
W57 - Console 212-2261-001 Cable, AC Power



W58 - Console 212-2381-001 Cable, ATX Power



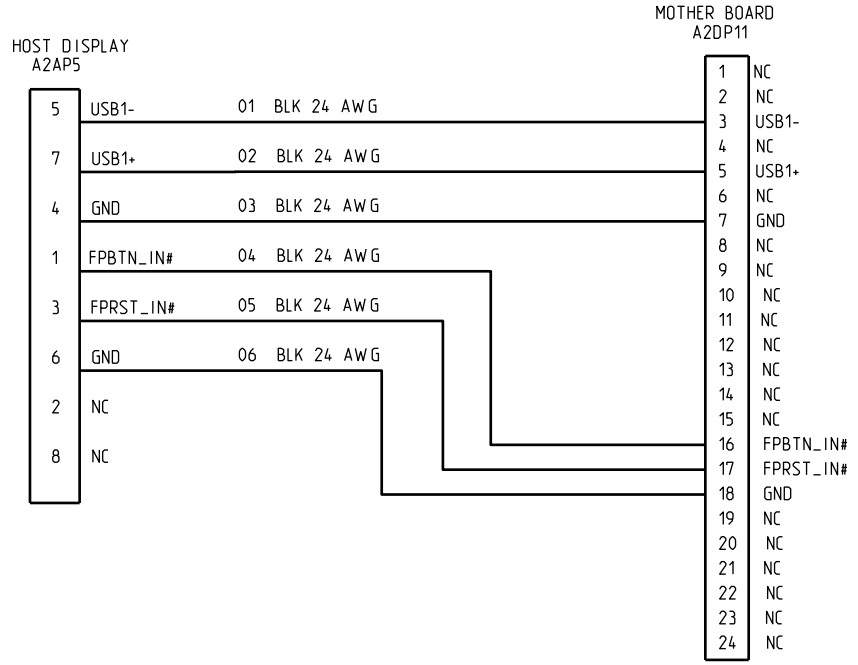
W59, 60 - Console 212-2382-001 Cable, SATA Power



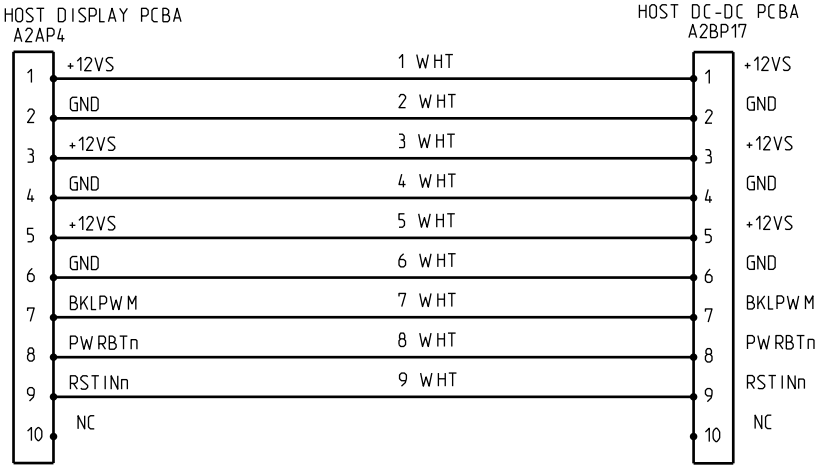
W63 - Console 212-2384-001 Cable, DVD Power

TABLE: CONNECTOR PIN OUT					
CONNECTOR PIN NO.	CONDUCTOR NO.	SIGNAL NAME	CONNECTOR PIN NO.	CONDUCTOR NO.	SIGNAL NAME
1	1	RESET	2	3	GROUND
3	5	DATA 7	4	7	DATA 8
5	9	DATA 6	6	11	DATA 9
7	13	DATA 5	8	15	DATA 10
9	17	DATA 4	10	19	DATA 11
11	21	DATA 3	12	23	DATA 12
13	25	DATA 2	14	27	DATA 13
15	29	DATA 1	16	31	DATA 14
17	33	DATA 0	18	35	DATA 15
19	37	GROUND	20	39	KEY
21	41	DMARQ	22	43	GROUND
23	45	DIOW-	24	47	GROUND
25	49	DIOR-	26	51	GROUND
27	53	IORDY	28	55	CSEL
29	57	DMARK-	30	59	GROUND
31	61	INTRQ	32	63	IOCS16-
33	65	DA1	34	67	PDIAG-(GND)
35	69	DA0	36	71	DA2
37	73	CS1FX-	38	75	CS3FX-
39	77	DASP-	40	79	GROUND
ALL EVEN CABLE CONDUCTOR NUMBERS ARE GROUND					

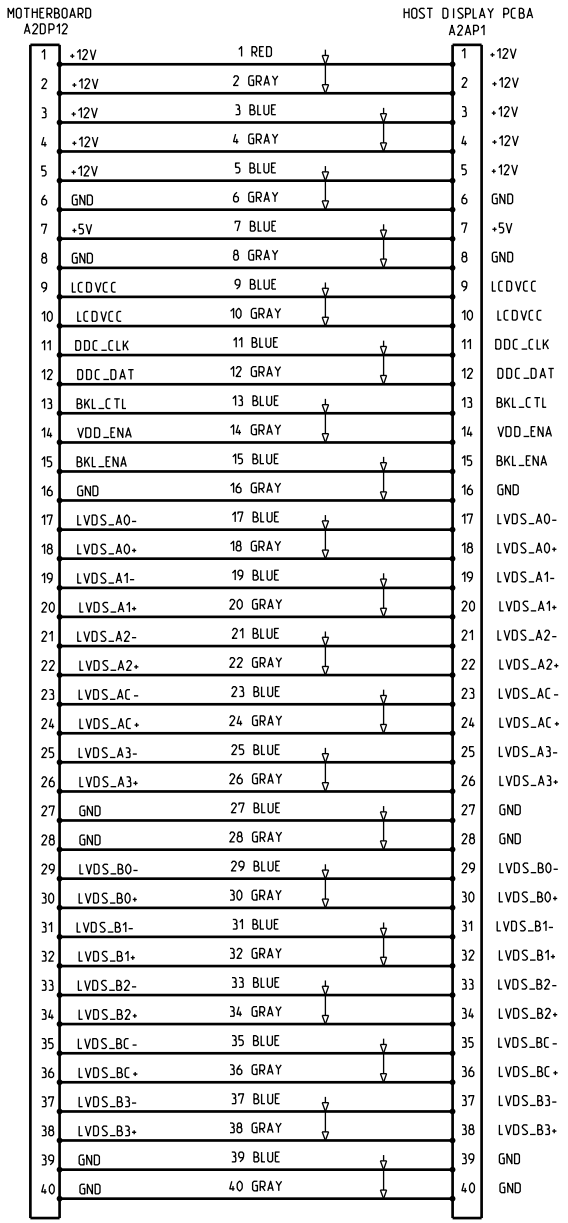
W64 - Console 212-2385-001 Cable, IDE Signal



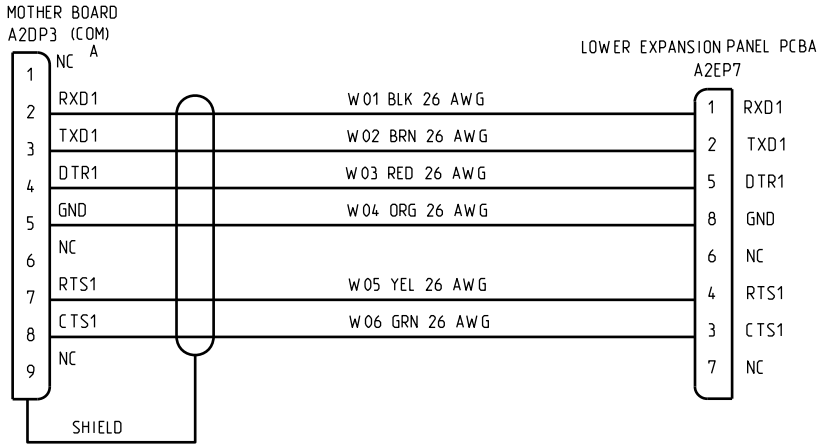
W66 - Console 212-2387-001 Cable, Front Panel USB



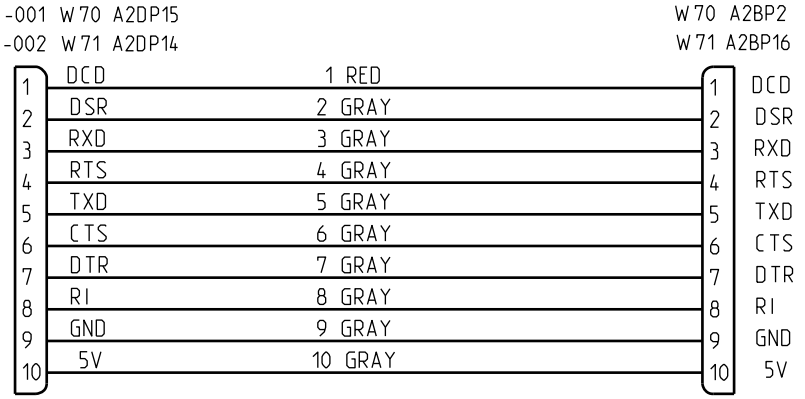
W68, 79 - Console 212-2389-001 Cable, Power Front Panel



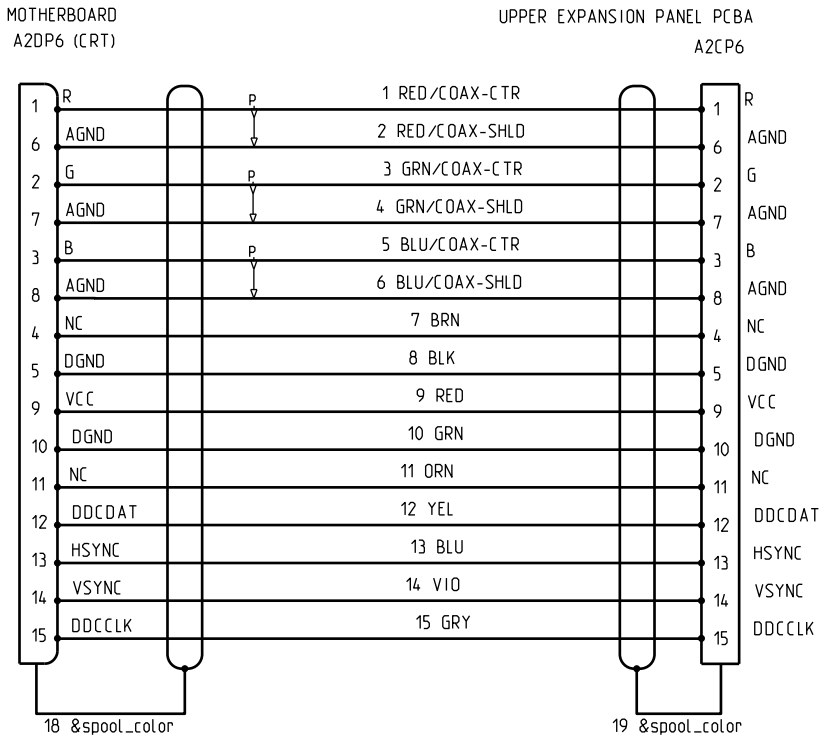
W67 - Console 212-2388-001 Cable, LVDS Signal



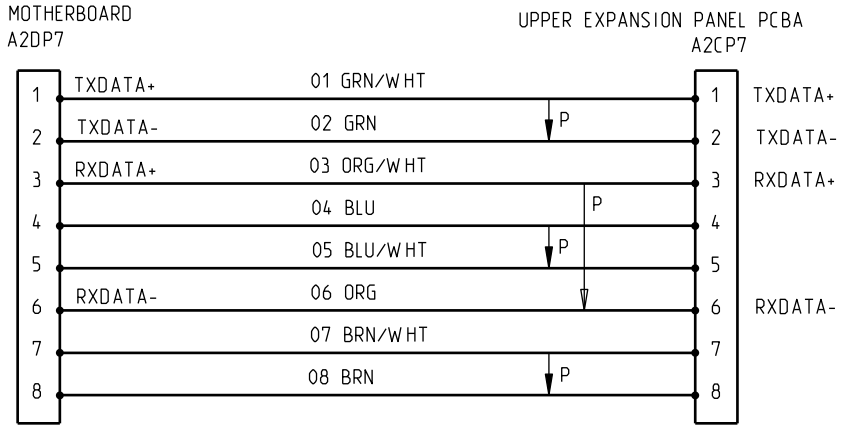
W69 - Console 212-2390-001 Cable, Serial, IO Ext



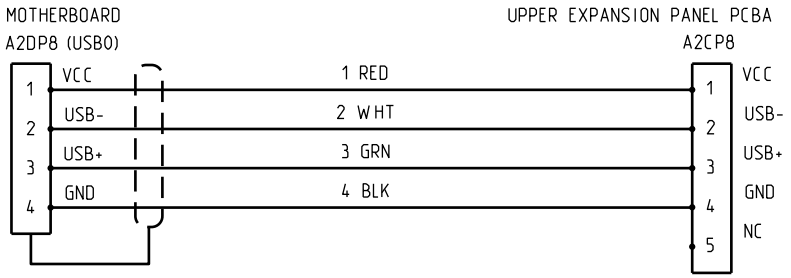
W70, 71 - Console 212-2391-XXX Cable, Serial, Ext



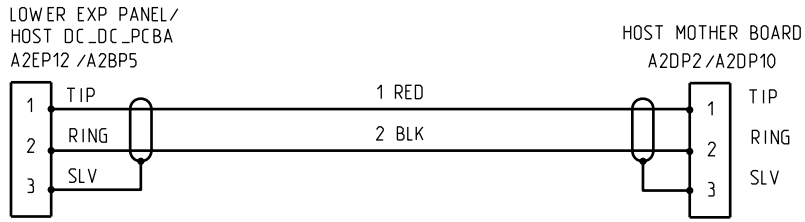
W72 - Console 212-2392-001 Cable, VGA, Ext



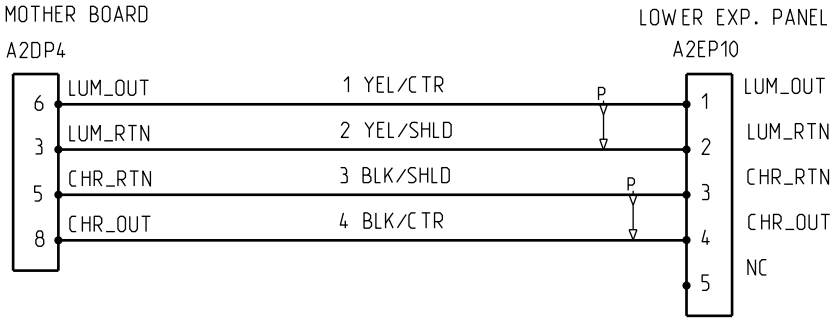
W73 - Console 212-2393-001 Cable, Ethernet Extn



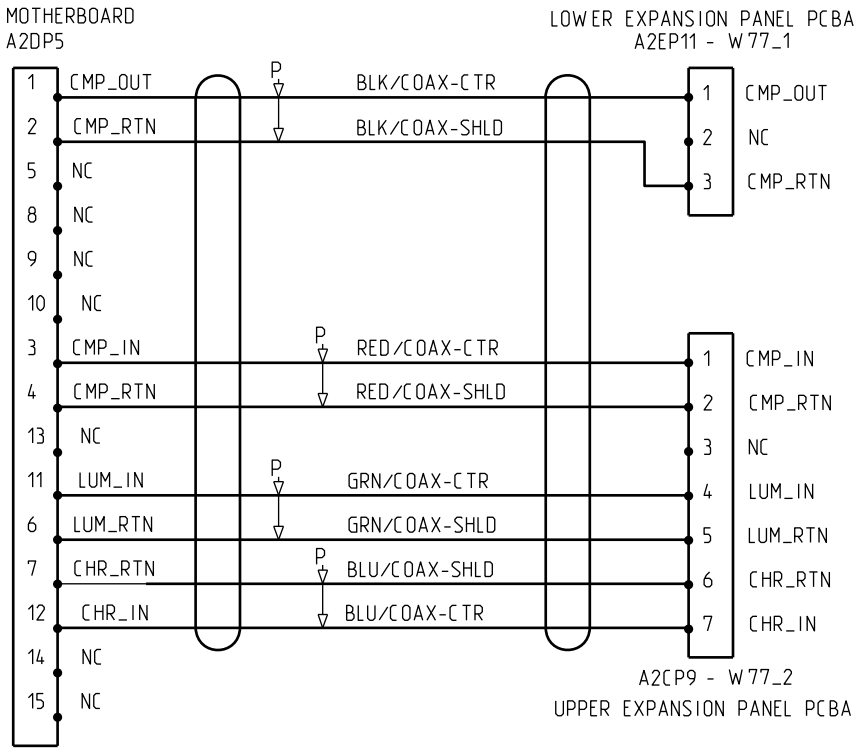
W74 - Console 212-2394-001 Cable, USB, Port Ext



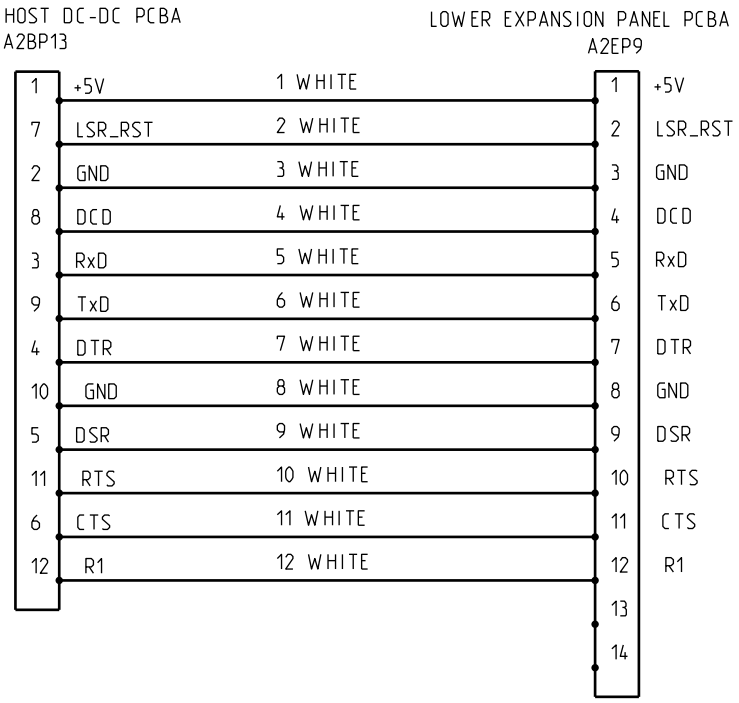
W75, 76 - Console 212-2395-001 Cable, Audio Ext



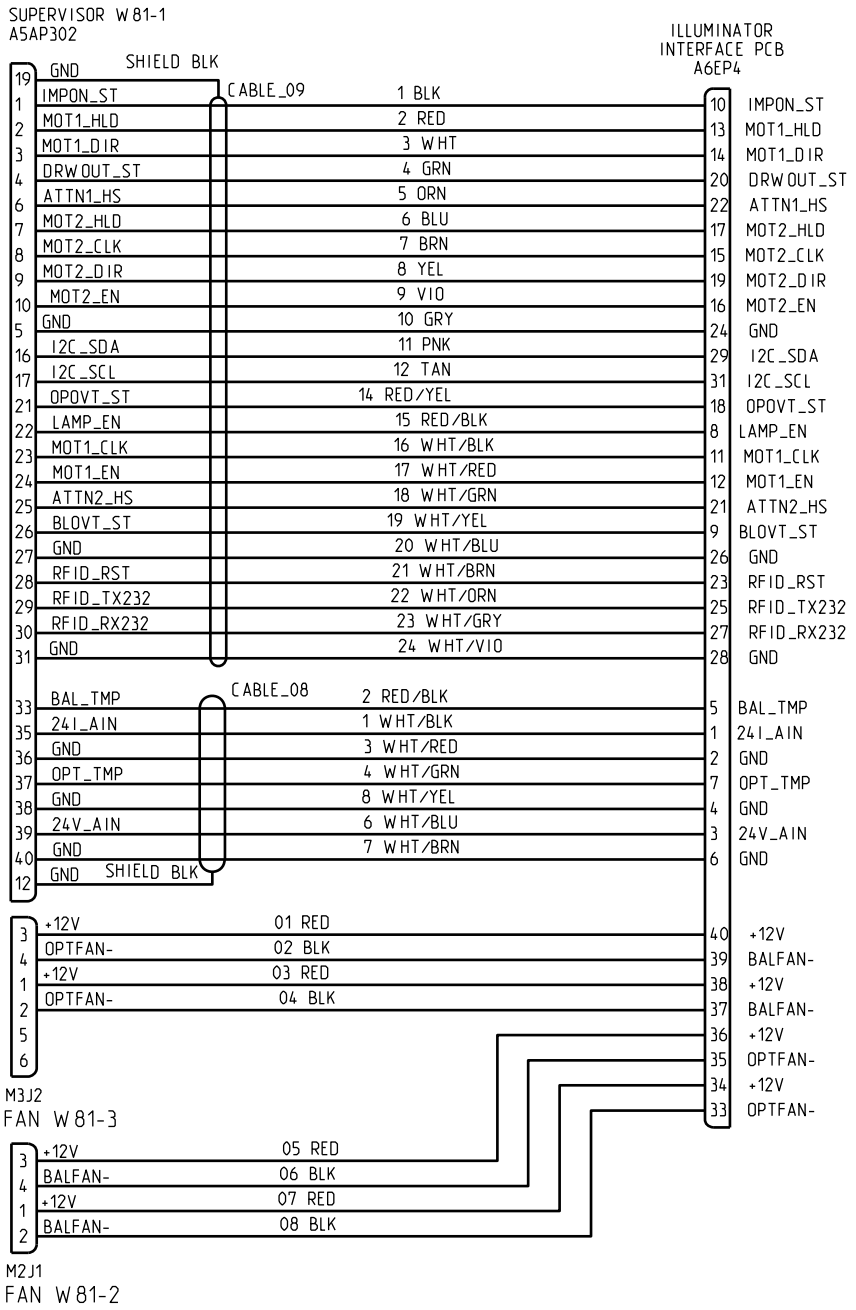
W78 - Console 212-2397-001 Cable, S-Video, Out Ext



W77 - Console 212-2396-001 Cable, VOM Signal, Ext

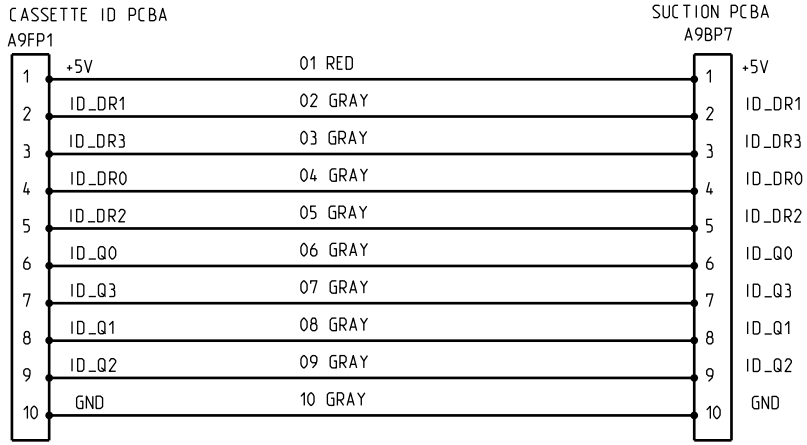


W80 - Console 212-2399-001 Cable, Expansion Pwr Sgnl

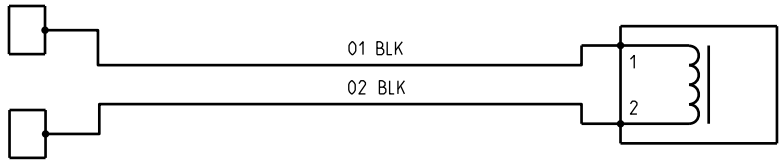


W81 - Console 212-2499-001 Cable, I/O Control

W84, 160 - Console 212-2937-001 Cable, Fluidics Fan

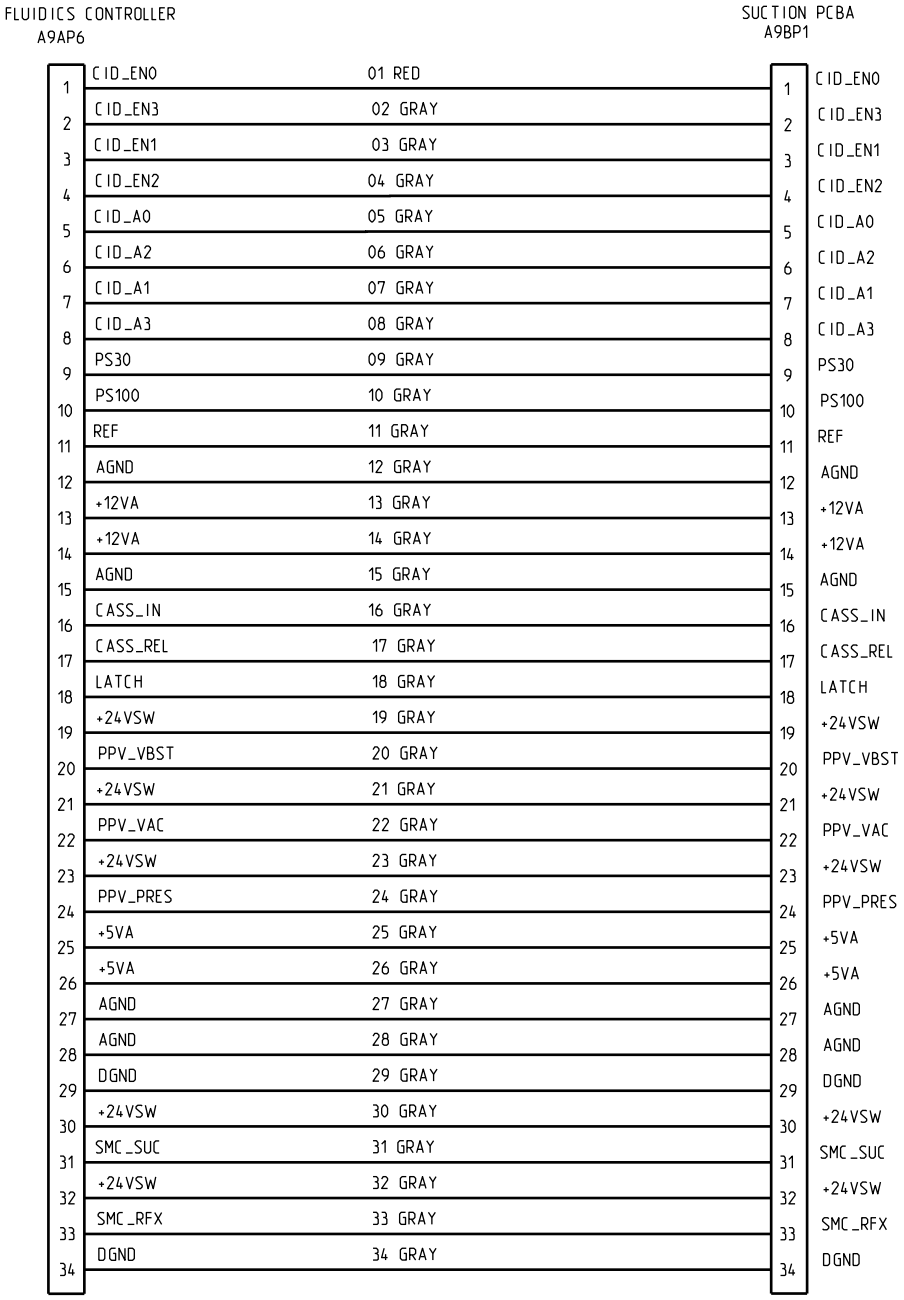


W85 - Console 212-2293-001 Cable, Cassette ID

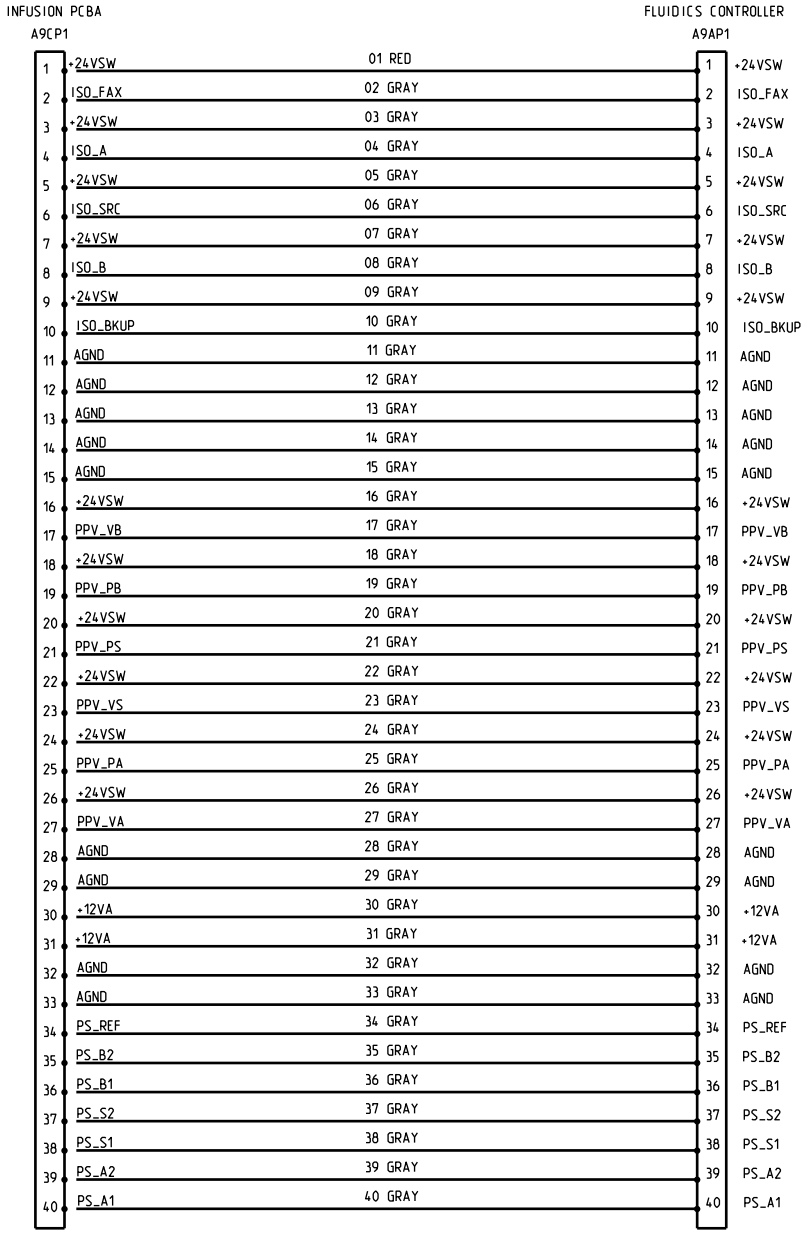


W89, 91 - Console 212-2633-001 Cable, Prop Valve

Cables, Interconnect, Constellation Vision System

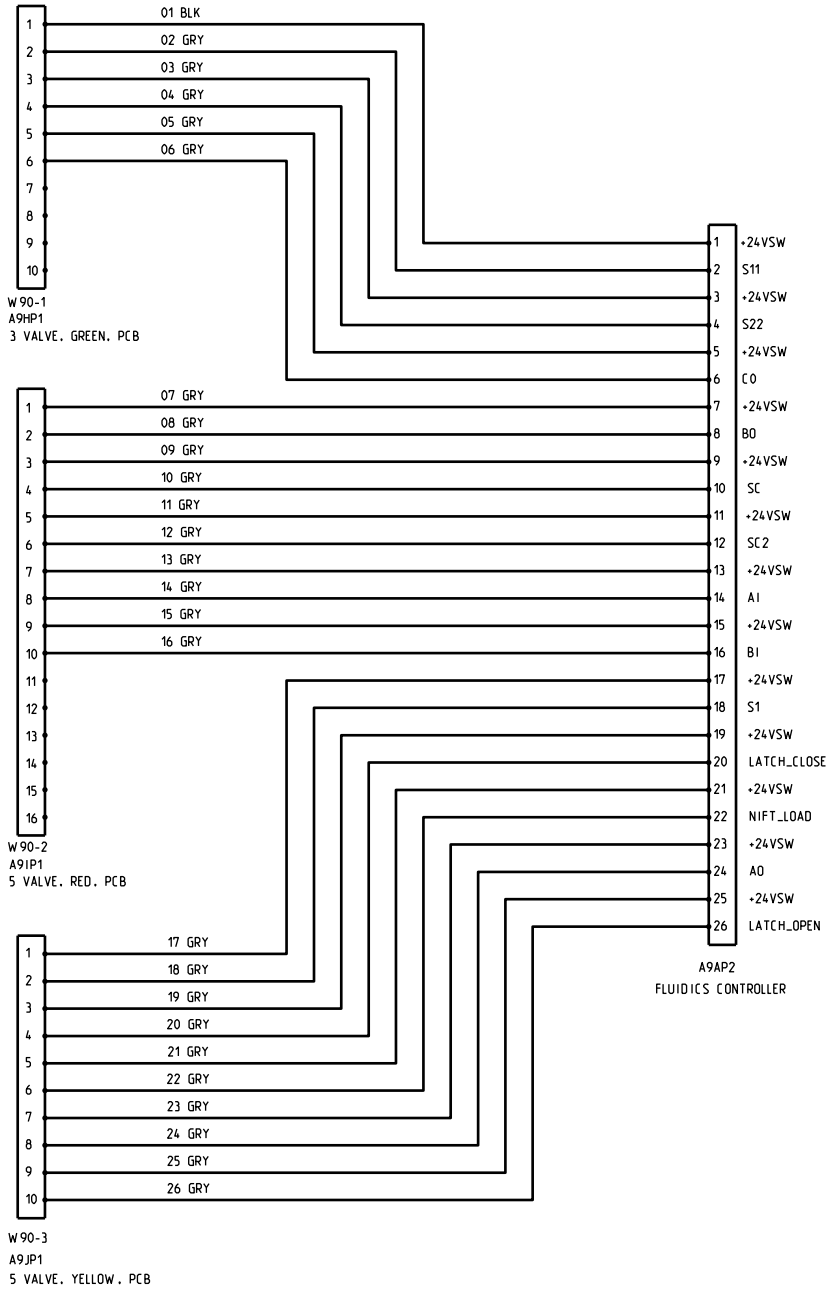


W86 - Console 212-2291-001 Cable, Suction Control

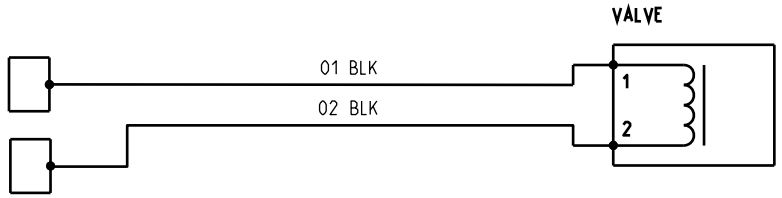


W88 - Console 212-2252-001 Cable, Inf Controller

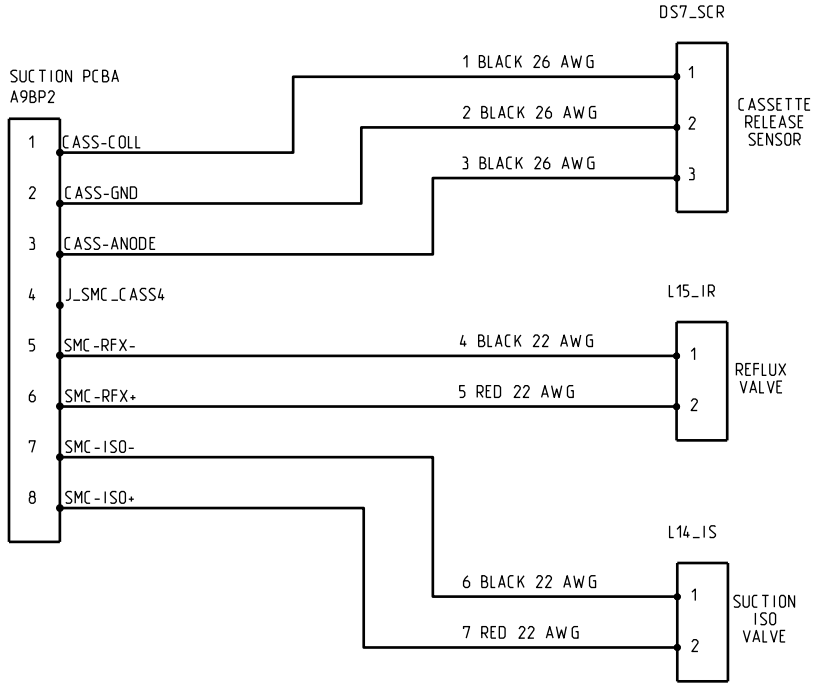
Cables, Interconnect, Constellation Vision System



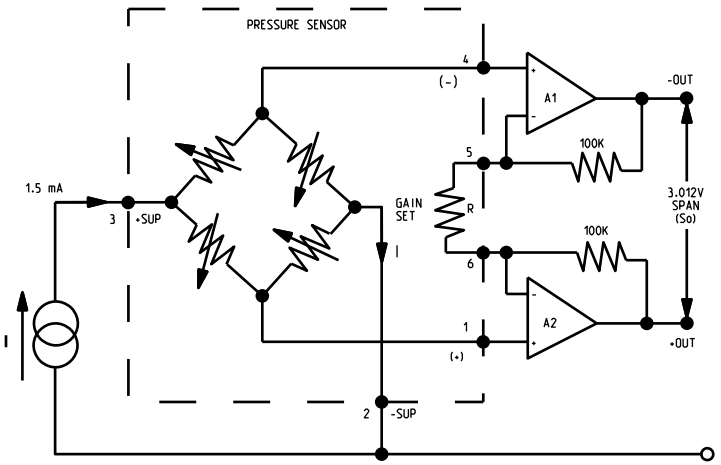
W90 - Console 212-2288-001 Cable, X Valve



W92, 109, 110, 111 - Console 212-2632-001 Cable, Prop Valve



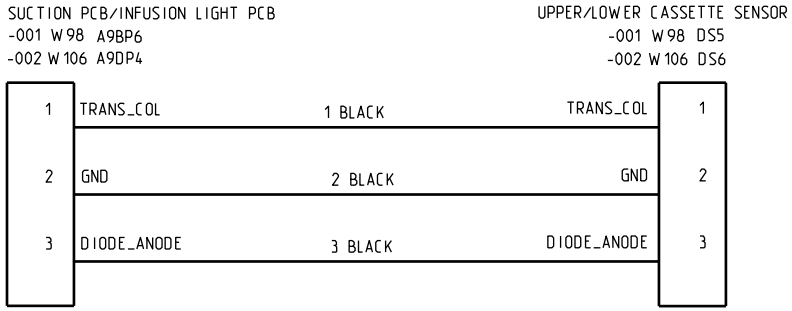
W95 - Console 212-2294-001 Cable, SMC Cass-Rel



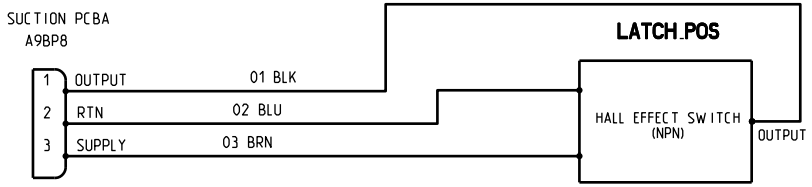
PAD/WIRE NO	FUNCTION
1	+OUT
2	-EX
3	+EX

PAD/WIRE NO	FUNCTION
4	-OUT
5	GAIN
6	GAIN

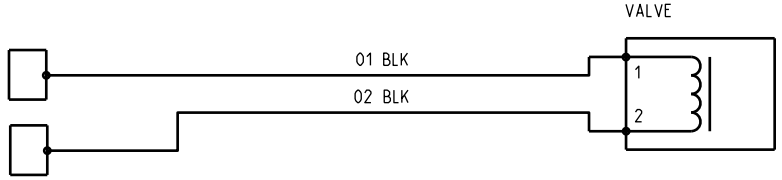
W96 - Console 212-2580-001 Sensor, Pressure, ABS 30
W97 - Console 212-2579-001 Sensor, Pressure, ABS 100



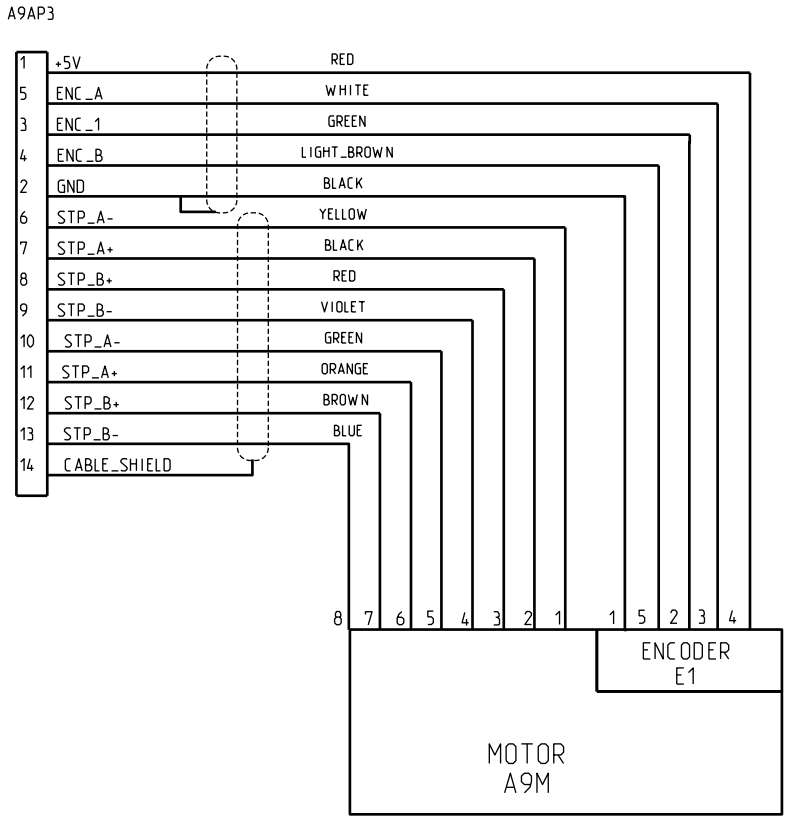
W98, 106 - Console 212-2292-xxx Cable, Cass In Sensor



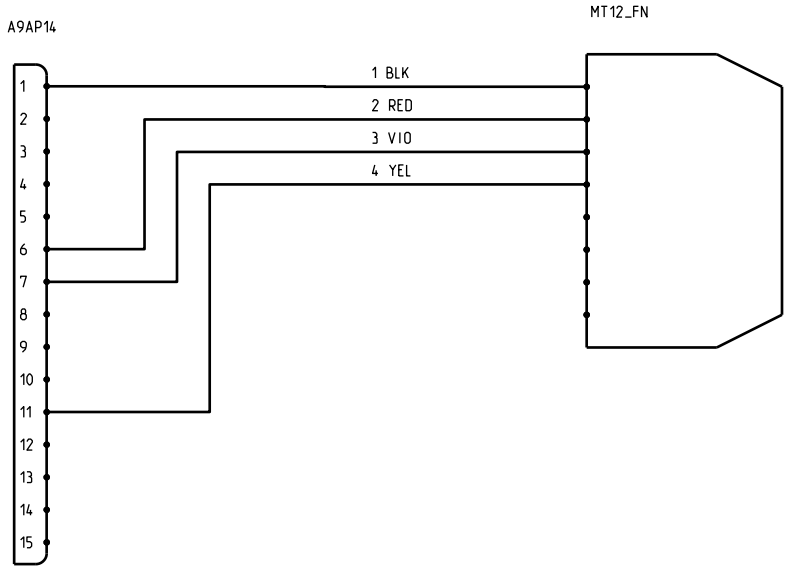
W99 - Console 212-2272-001 Cable, Latch Pos



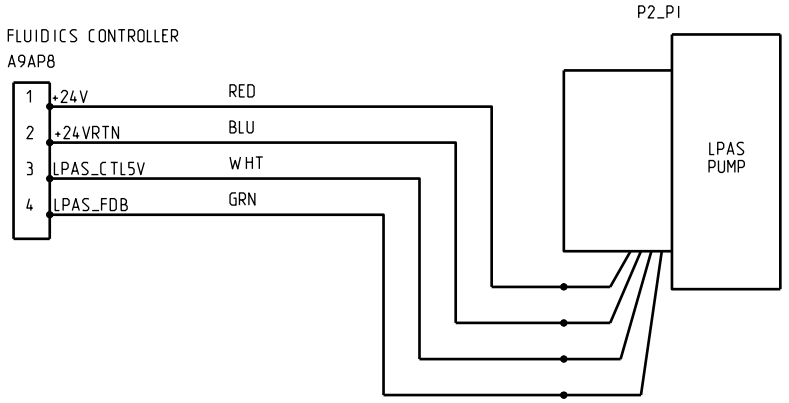
W100, 107, 108 - Console 212-2634-001 Cable, Prop Valve, LW



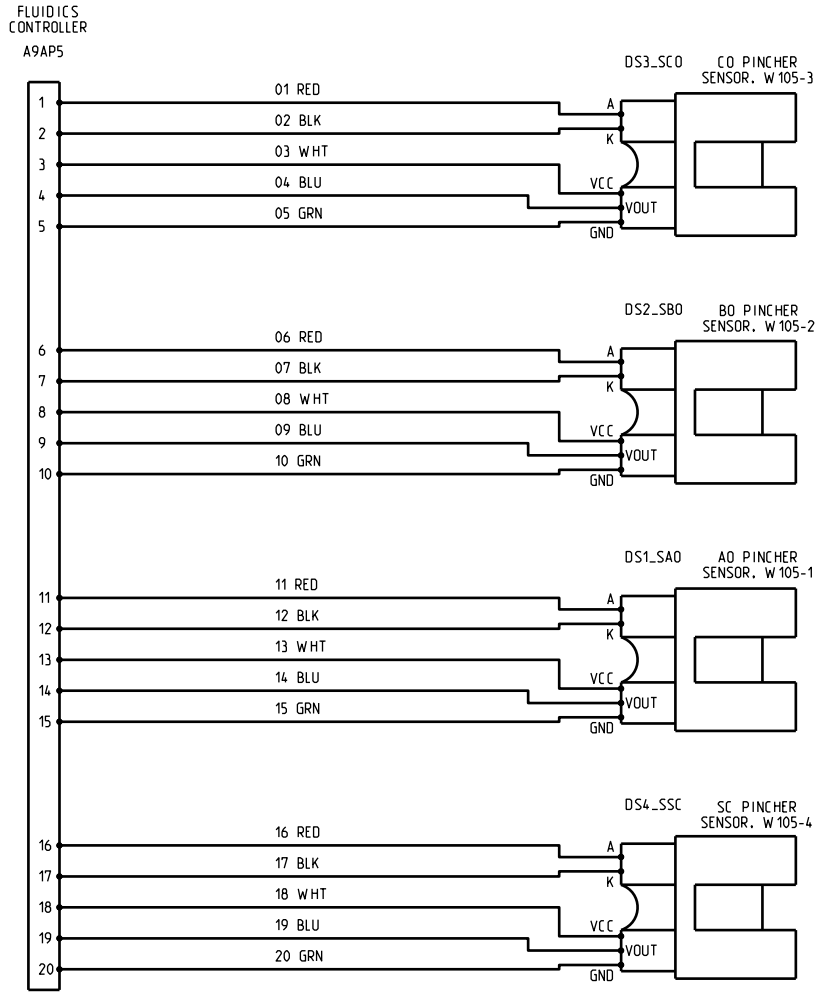
W101 - Console 212-2575-001 Motor, Stepper W/Encoder



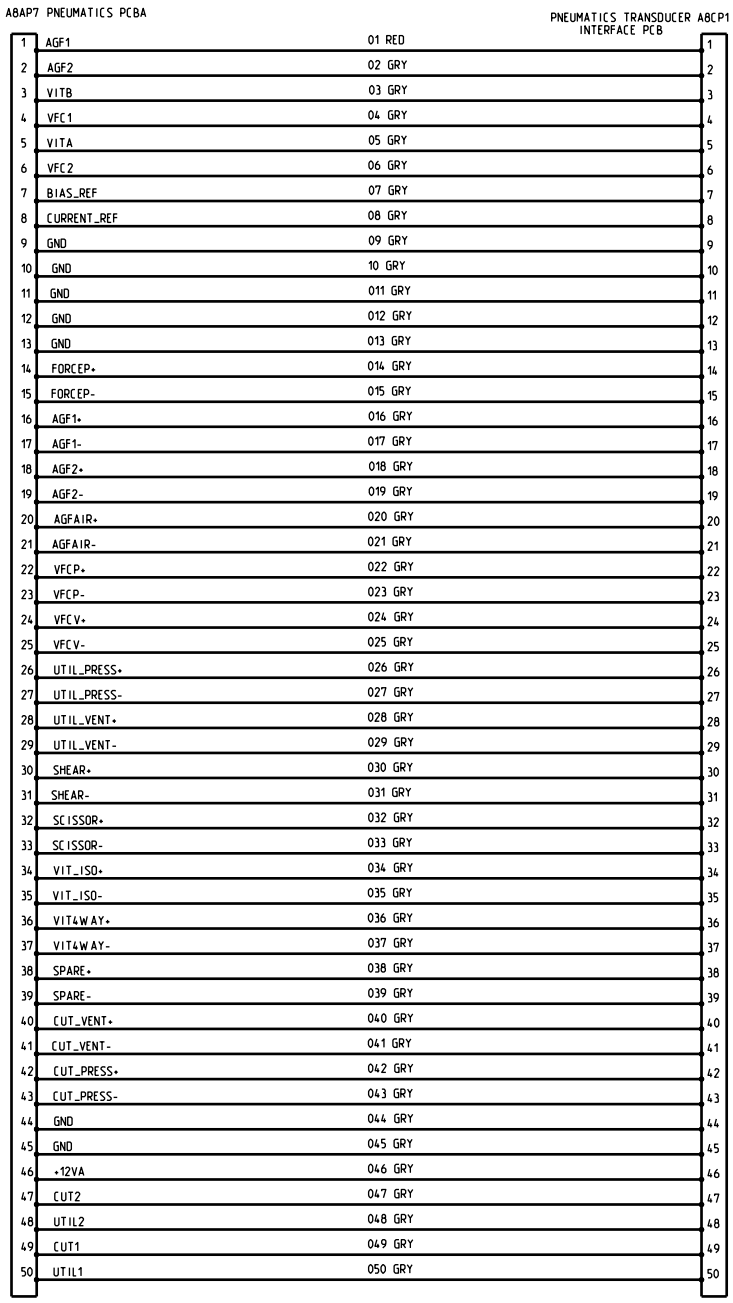
W103 - Console 212-2308-001 Cable, Sensor, Flow



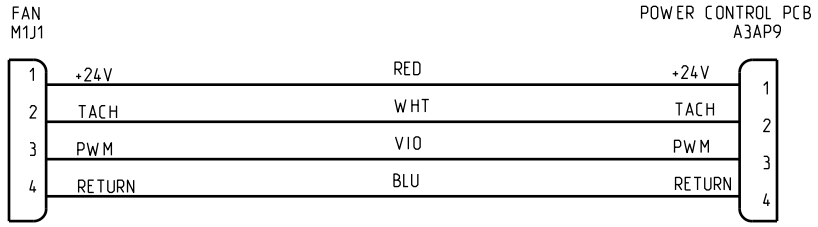
W104 - Console 212-2290-001 Cable, LPAS Pump



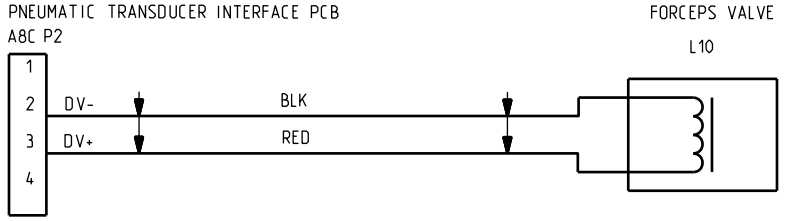
W105 - Console 212-2284-001 Cable, Sens, Pincher



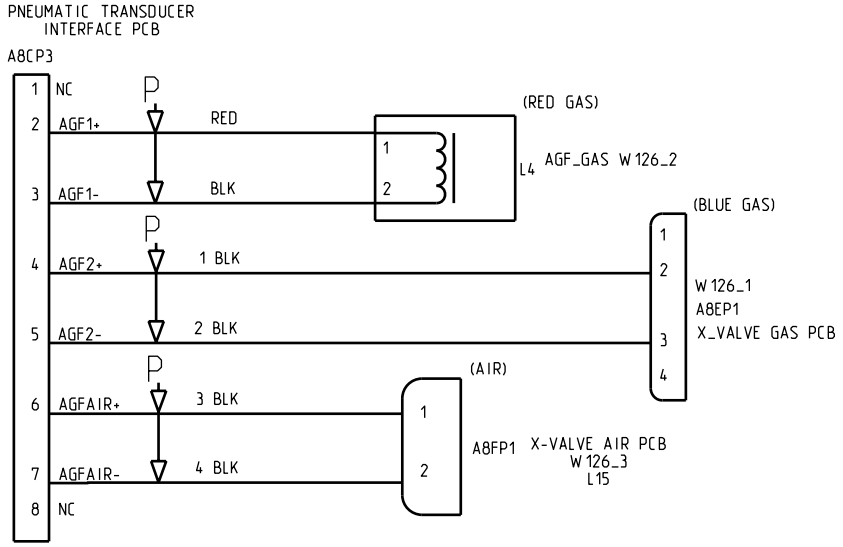
W122 - Console 212-2596-001 Cable, Pneu, Interface



W112 - Console 212-2504-001 Cable, Fan

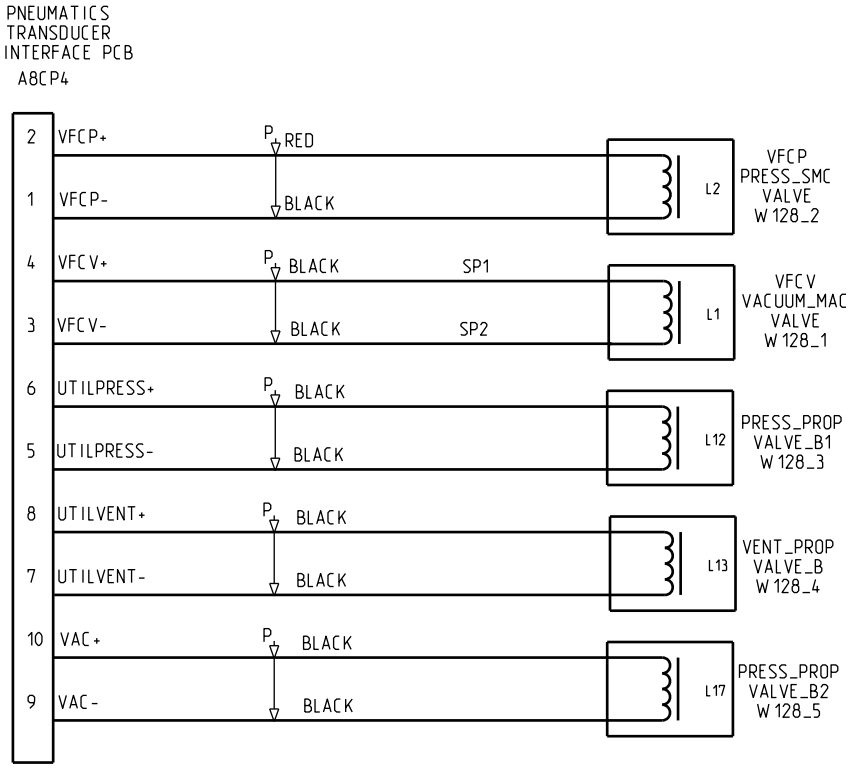


W125, 129, 130 - Console 212-2591-001 Cable, SMC Valve

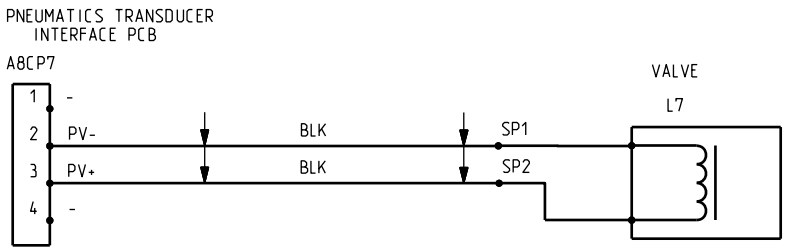


W126 - Console 212-2747-001 Cable, W126

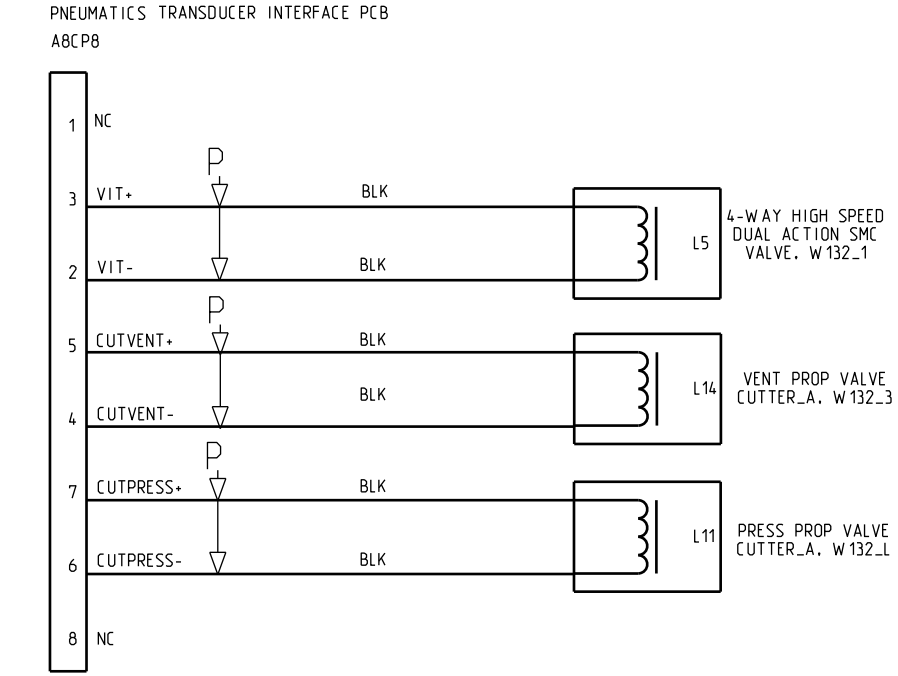
Cables, Interconnect, Constellation Vision System



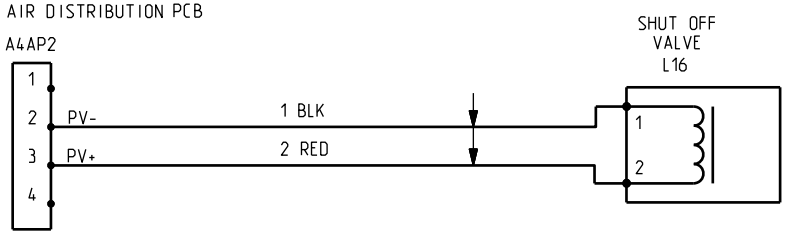
W128 - Console 212-2748-001 Cable, W128



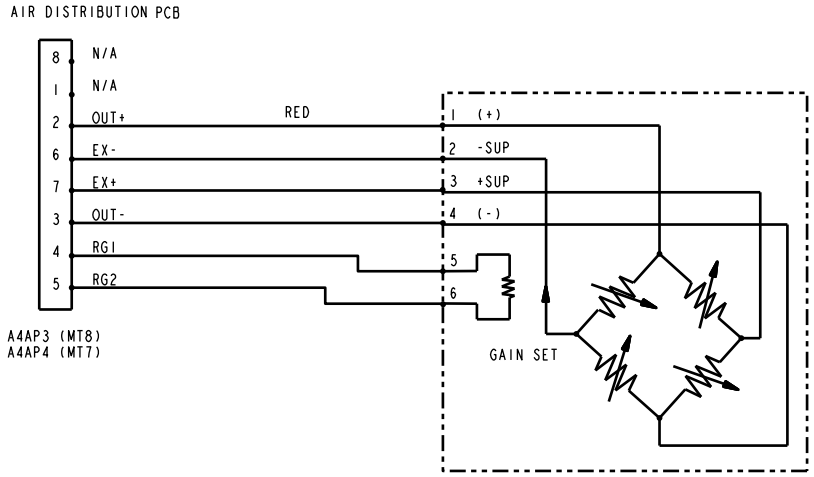
W131 - Console 212-2594-001 Cable, Vit



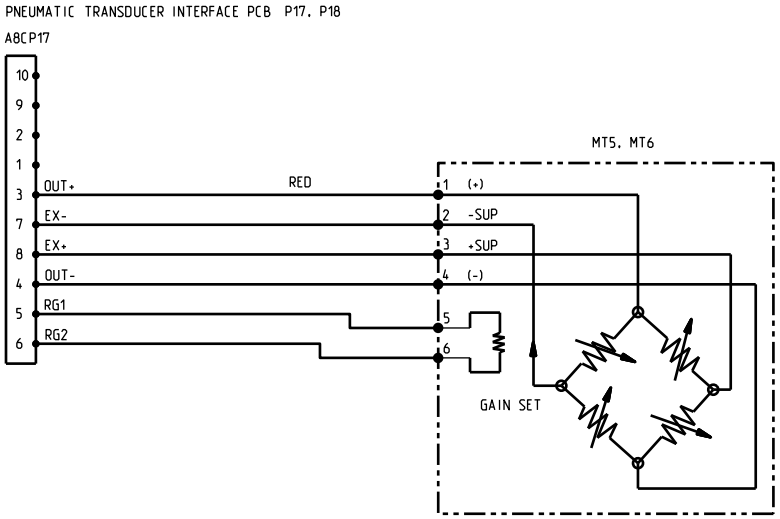
W132 - Console 212-2749-001 Cable, W132



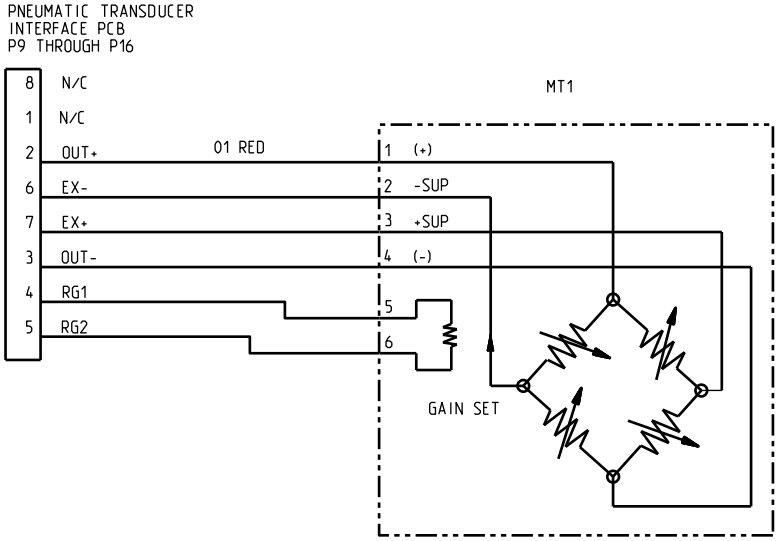
W135 - Console 212-2593-001 Cable, SMC Valve



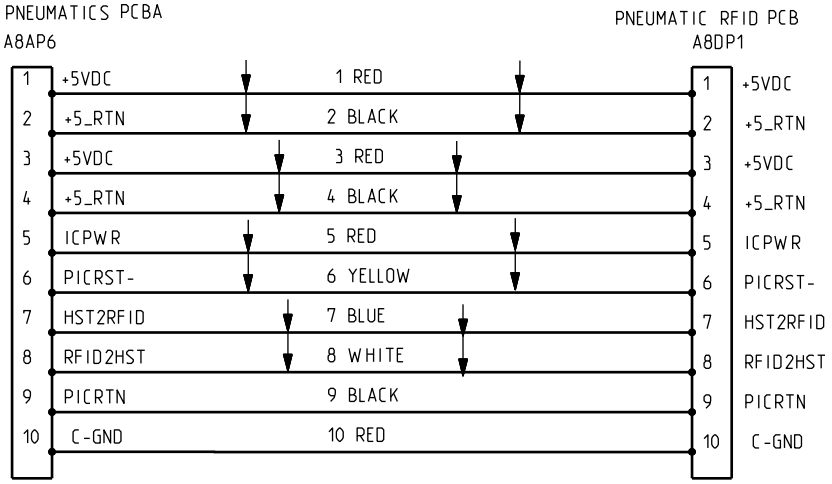
W136, 137 - Console 212-2588-001 Cable, Press Snsr 300



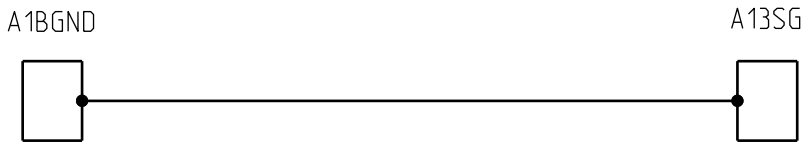
W147, 149 - Console 212-2589-001 Cable, Press Snsr 30



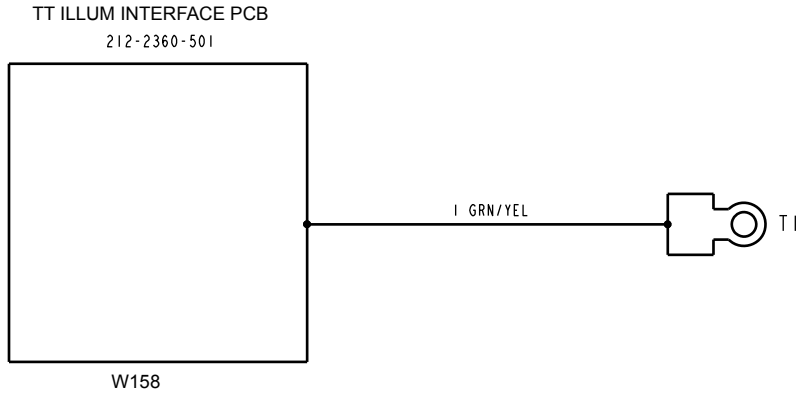
W139-146 - Console 212-2590-001 Cable, Press Snsr 100



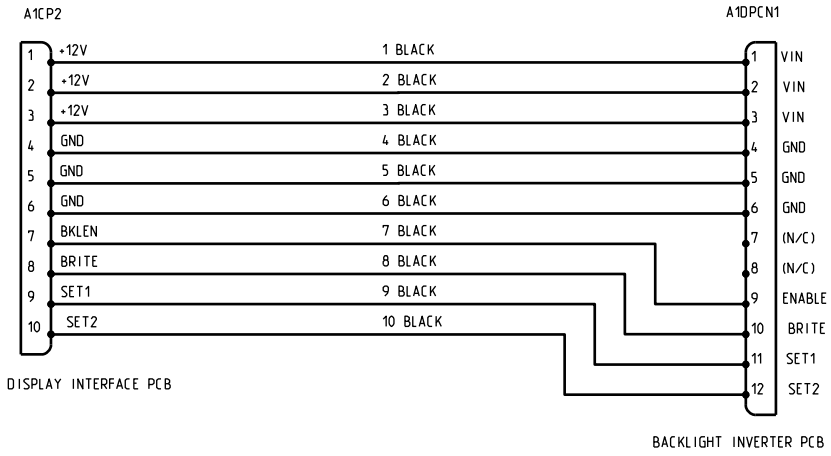
W148 - Console 212-2595-001 Cable, RFID



W157 Console 212-2281-001 Ground Strap, Display



W158 - Console 212-2667-001 Cable, Illum Ground Strap



W161 - Console 212-1873-001 Cable, Display, BLT Invert

W162 - Console 212-1874-001 Cable, Display, IR Snsr Rt

W163 - Console 212-1874-002 Cable, Display, IR Snsr Lft

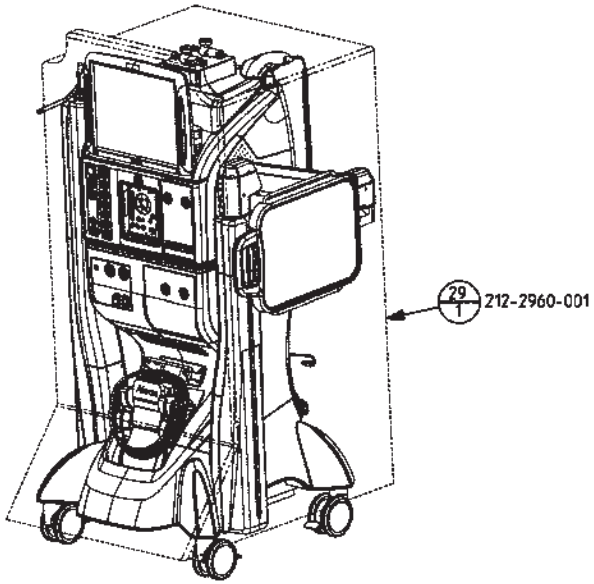
W164 - Console 212-1876-001 Cable, Disp, SD Card Reader

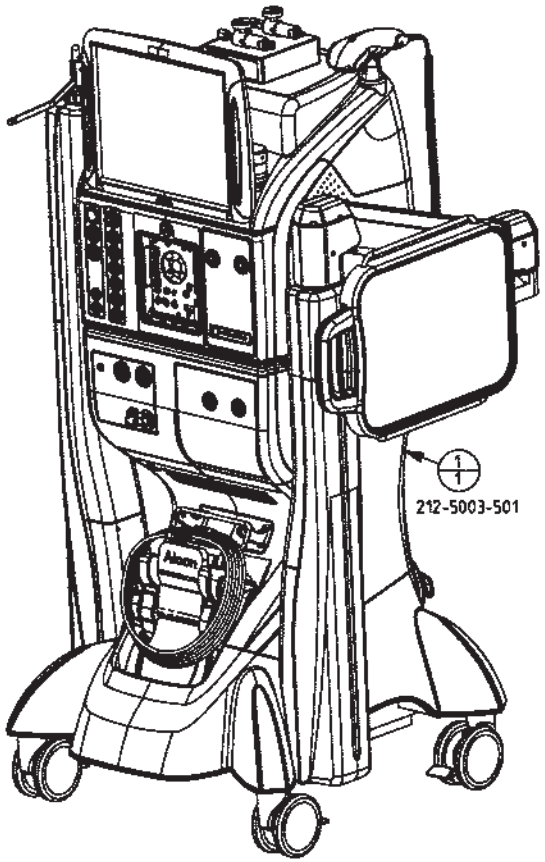
SECTION SIX
PARTS LISTS & DRAWINGS

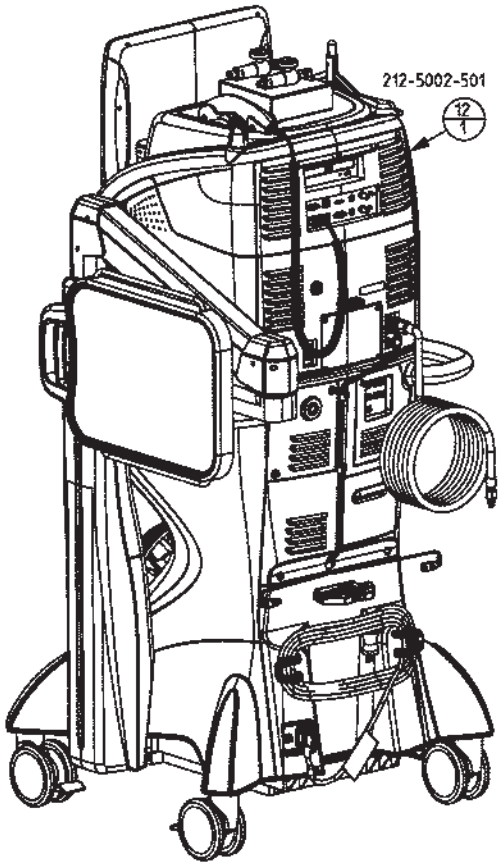
CONTENTS

ITEM	PART#	DESCRIPTION	QTY
	212-0000-501	**ASSY, CONSTELLATION, PREMIUM**	
001	212-5003-501	ASSY,BASE UNIT,PREMIUM	1.00 EA
003	212-1478-001	BALLAST,BASE UNIT	4.00 EA
004	807-063	SCREW,CAP HD SKT,M8X35 SST	4.00 EA
005	212-2538-001	TRAY,BALLAST,MACHINE	1.00 EA
006	807-061	SCREW,CAP HD SKT,M8X25 SST	4.00 EA
007	801-008	WASHER,FLAT,M8 SST	6.00 EA
008	212-1190-501	ASSY,COLUMN,TRAY ARM	1.00 EA
009	782-262	SCREW,SHOULDER,M6X1 303 SST	4.00 EA
010	212-1004-501	ASSY,ARM,TRAY	1.00 EA
011	212-5004-501	ASSY,IV POLE	1.00 EA
012	212-5002-501	ASSY,TABLE TOP	1.00 EA
013	212-2959-501	ASSY,HANGER,STATIONARY	1.00 EA
015	212-2248-001	SCANNER,BAR CODE	1.00 EA
016	8065750977	ASSY,FOOTSWITCH,CONSTEL	1.00 EA
017	212-2650-001	HOSE ASSY,SUPPY,GAS	1.00 EA
018	212-1448-001	PANEL,TABLETOP,REAR CONN	1.00 EA
019	825-020	SCREW,CAP HD SKT,M4X35 SST	2.00 EA
020	212-2690-501	ASSY,HOLDER,SCANNER	1.00 EA
024	212-2981-501	ASSY,GAS AGF,EXTERNAL	1.00 EA
027	8065750968	ASSY,SHIP,REMOTE CONSTEL	1.00 EA
028	212-2988-001	LABEL,NOT FOR SALE	1.00 EA
029	212-2960-001	COVER,DUST,MONOLITH	1.00 EA

TABULATION	
PART NUMBER	DESCRIPTION
212-0000-501	ASSY, CONTELLATION, PREMIUM
212-0000-502	ASSY, CONTELLATION, NO IV POLE
212-0000-503	CONSTELLATION, NO IV POLE/LASER

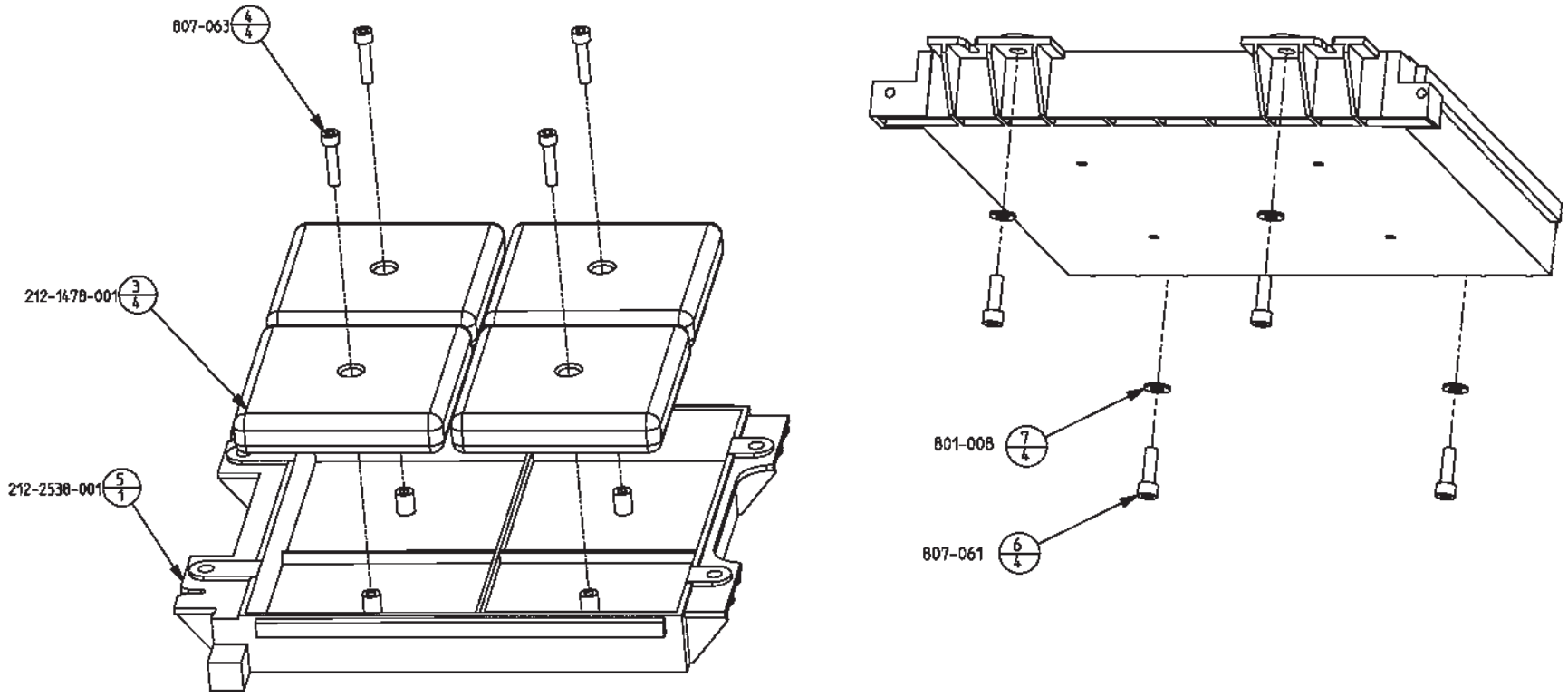




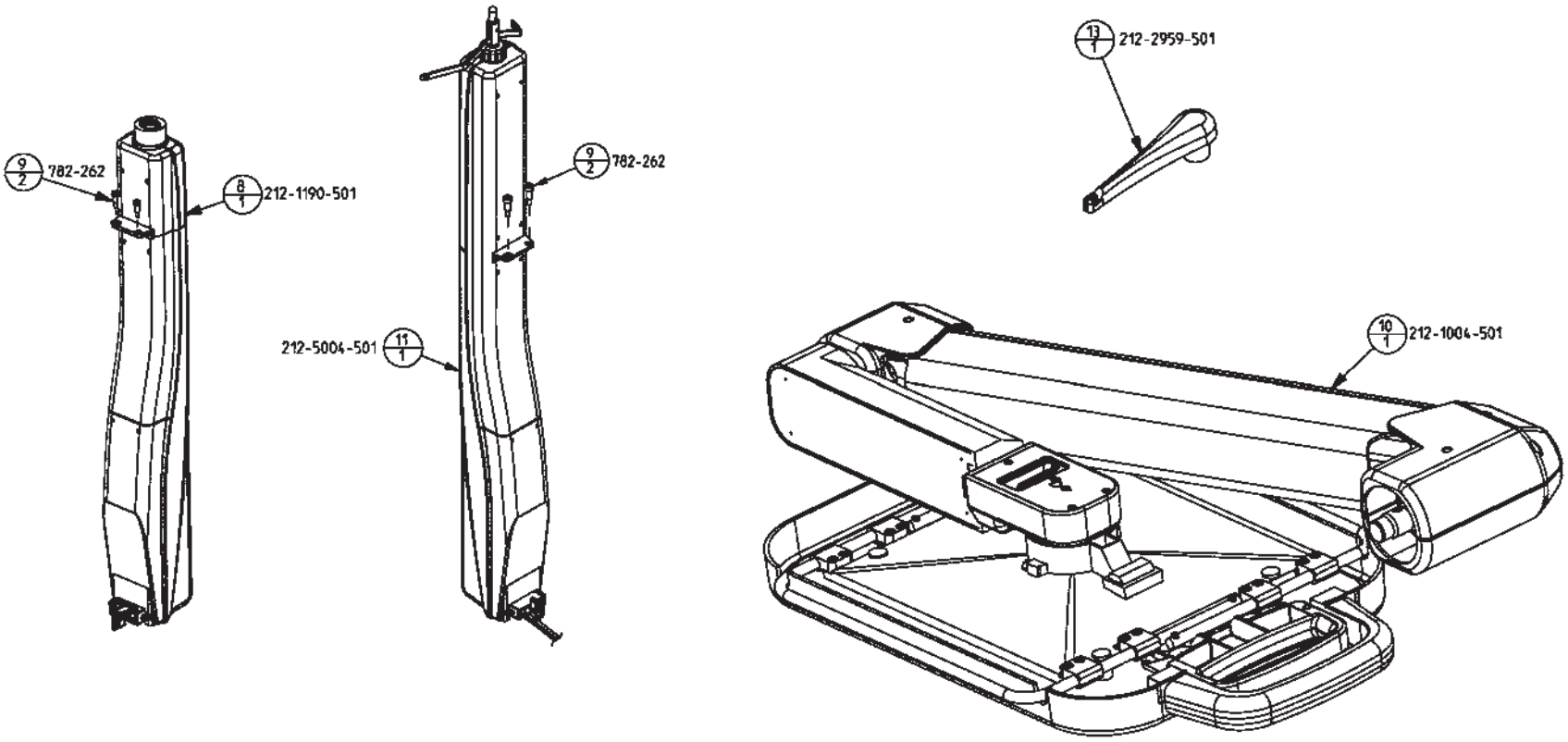


212-0000-501 SHOWN

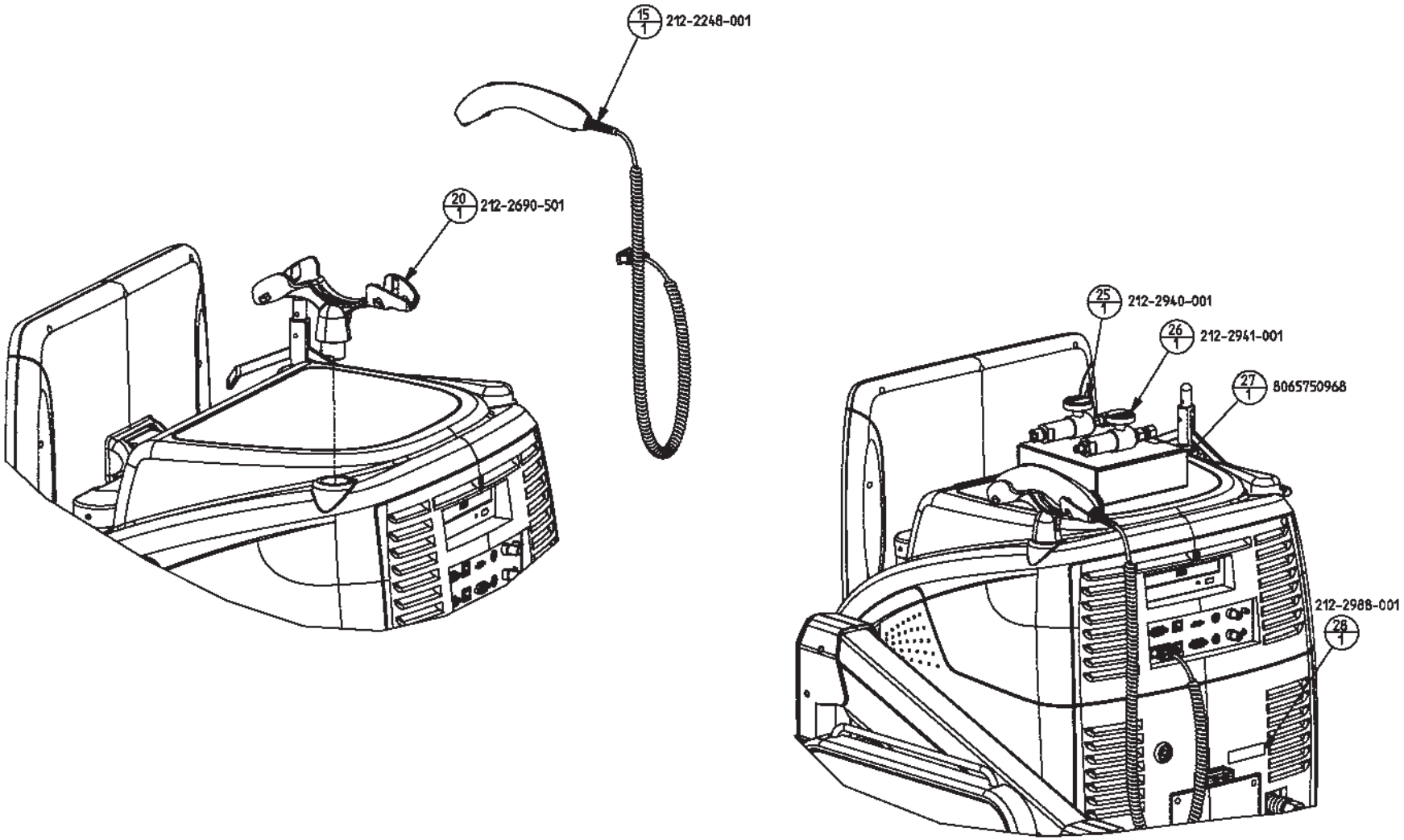
212-0000-XXX ASSY, CONSTELLATION, PREMIUM (1 of 5)



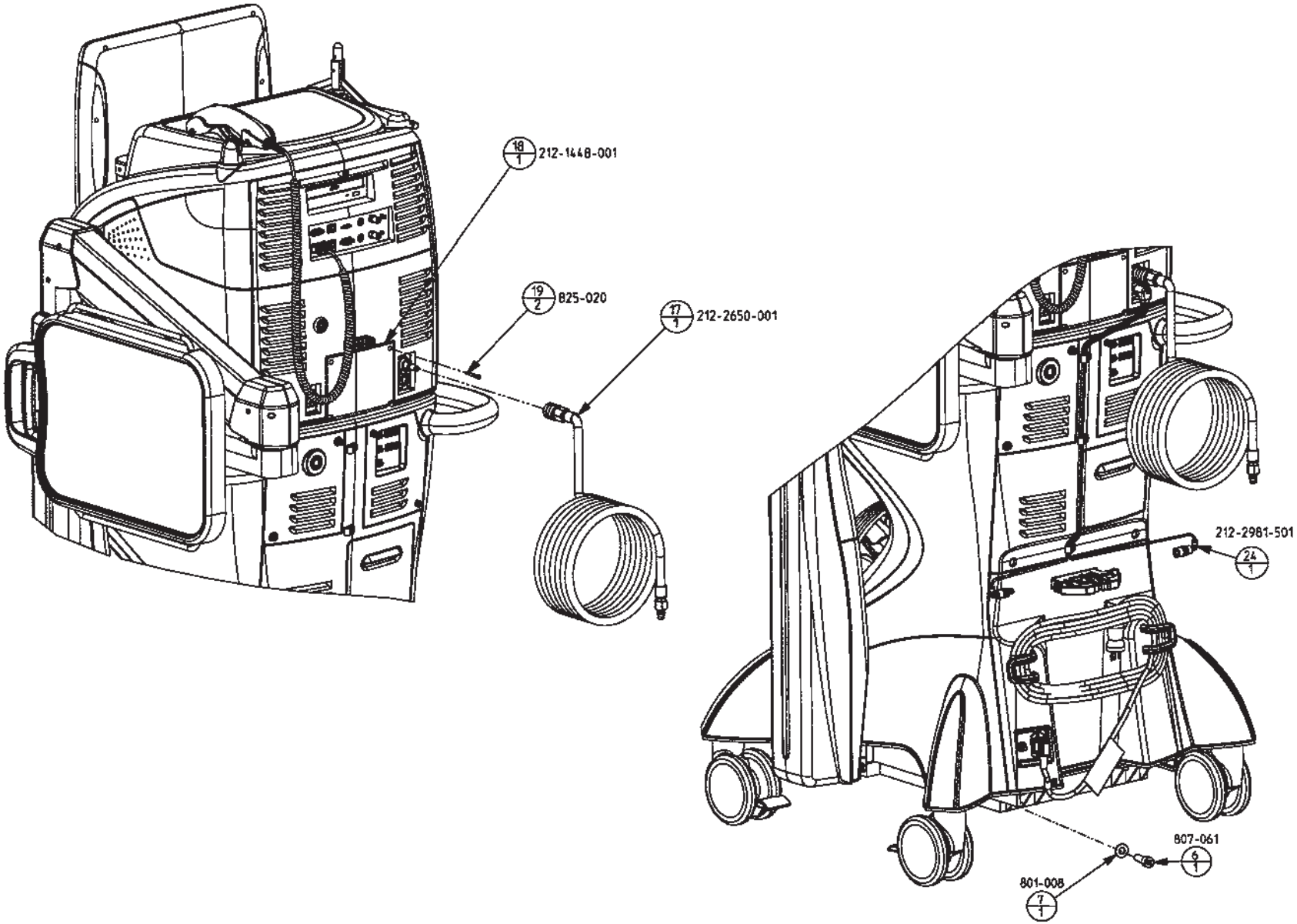
212-0000-XXX ASSY, CONSTELLATION, PREMIUM (2 of 5)



212-0000-XXX ASSY, CONSTELLATION, PREMIUM (3 of 5)



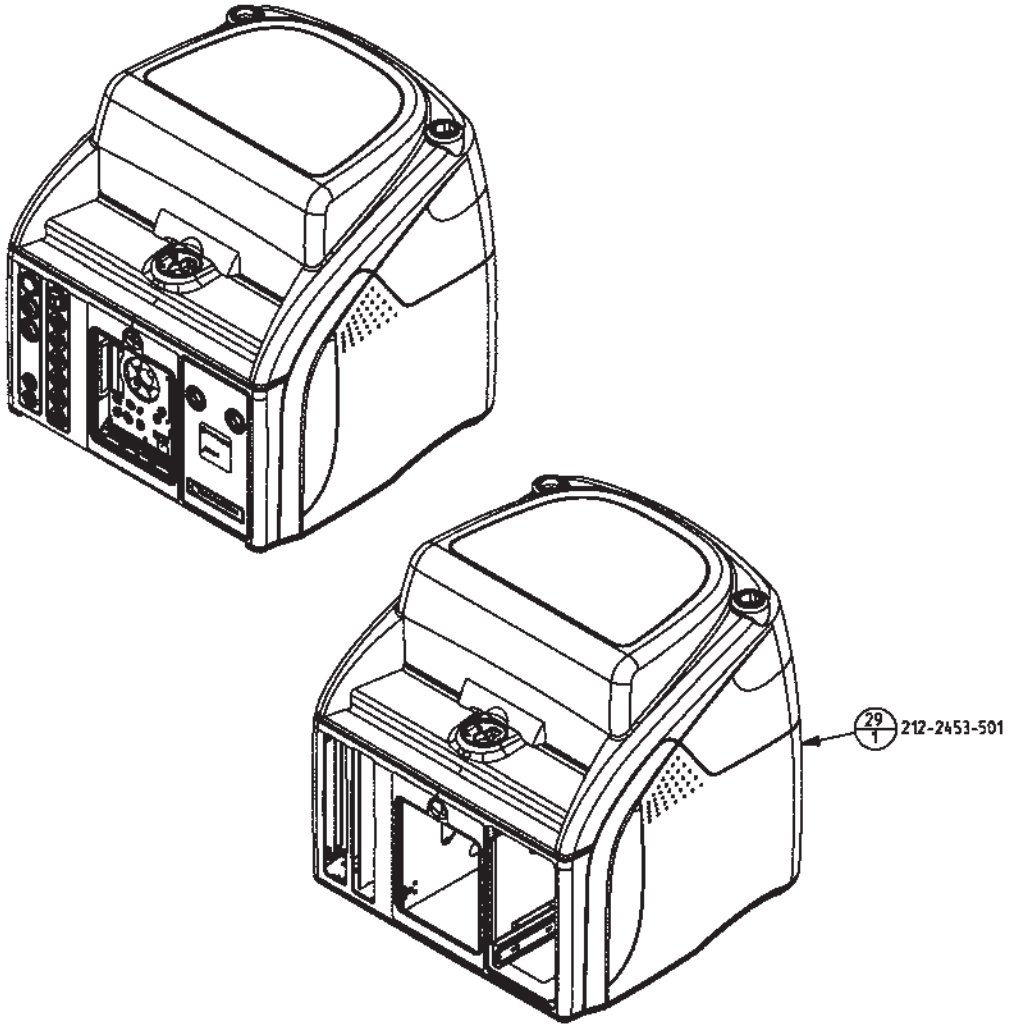
212-0000-XXX ASSY, CONSTELLATION, PREMIUM (4 of 5)



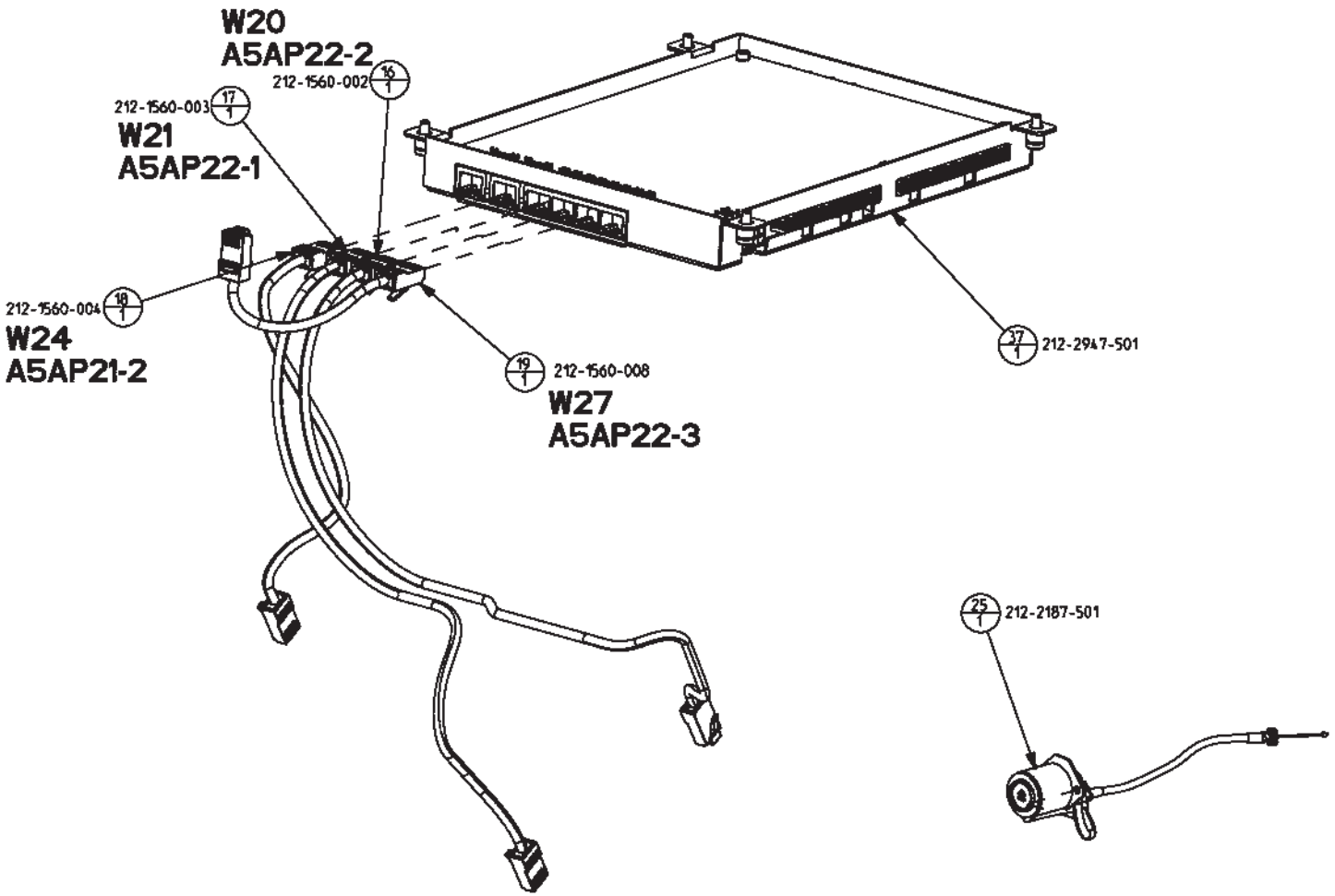
212-0000-XXX ASSY, CONSTELLATION, PREMIUM (5 of 5)

constellation VISION SYSTEM

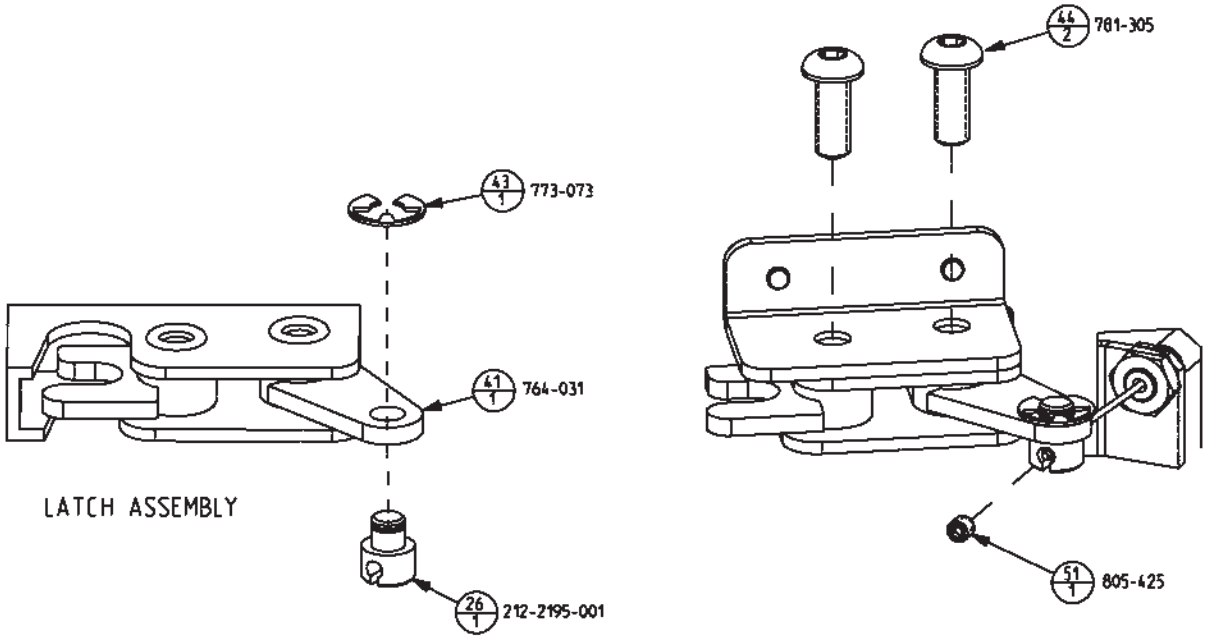
ITEM	PART#	DESCRIPTION	QTY
	212-5002-501	**ASSY, TABLETOP**	
001	027-003	CABLE TIE,.625X3.50L,NYLON	11.00 EA
002	027-004	CABLE TIE,2.00X8.00L,NYL	2.00 EA
003	027-009	CABLE TIE,3.00X11.00L,NYLON	7.00 EA
004	210-1575-001	BUTTON,SWITCH,STANDBY	1.00 EA
005	210-1626-501	ASSY,PCB,STAND-BY SWITCH	1.00 EA
006	212-1003-501	ASSY,ARM,DISPLAY	1.00 EA
007	212-1010-501	ASSY,MODULE,HOST	1.00 EA
008	212-1016-501	ASSY,MODULE,PWR CTRL	1.00 EA
009	212-1023-501	ASSY,PNEUMATIC,MODULE	1.00 EA
010	212-1037-501	ASSY,MODULE,U/S-DIAT AQUA	1.00 EA
011	212-1040-501	ASSY,FILTER,OIL/AIR DRYER	1.00 EA
012	212-1047-501	ASSY,ILLUMINATOR	1.00 EA
013	212-1445-501	ASSY,FLUIDICS	1.00 EA
014	212-1557-001	CABLE ASSY,SPEAKER,RIGHT W14	1.00 EA
015	212-1557-002	CABLE ASSY,SPEAKER,LEFT W15	1.00 EA
016	212-1560-002	CABLE ASSY,ETHERNET W20	1.00 EA
017	212-1560-003	CABLE ASSY,ETHERNET W21	1.00 EA
018	212-1560-004	CABLE ASSY,ETHERNET W24	1.00 EA
019	212-1560-008	CABLE ASSY,ETHERNET W27	1.00 EA
020	212-1561-002	CABLE ASSY,24V,DC W83	1.00 EA
021	212-1569-001	CABLE ASSY,SLOT ID,W26	1.00 EA
022	212-1586-001	CABLE ASSY,W43,FAN	1.00 EA
023	212-1879-002	DUCT,TABLE,LWR RIGHT GASKET	1.00 EA
024	212-2062-001	CABLE ASSY,PNEU DIST,W47	1.00 EA
025	212-2187-501	ASSY,ACTUATOR,LATCH ILLUM	1.00 EA
026	212-2195-001	ADAPTOR,CABLE,LATCH ILLUM	1.00 EA
027	212-2360-501	ASSY,PCB,FLOAT CONN TT ILLUM	1.00 EA
028	212-2421-001	BELLOWS,SOCK,ELASTOMERIC	2.00 EA
029	212-2453-501	ASSY,TABLETOP	1.00 EA
030	212-2499-001	CABLE ASSY,I/O CONTROL,W81	1.00 EA
031	212-2564-502	ASSY,PNL,REAR TT STAND ALONE	1.00 EA
032	212-2714-501	ASSY,BRACKET,CONNECT POWER	1.00 EA
033	212-3041-501	ASSY,DUCT,REAR ILLUMINATOR	1.00 EA
034	212-2780-SSC	KIT,SSC,HARN ASSY TABLETOP	1.00 EA
035	212-2824-001	BOLT,FL HD,SHOULDER,M4X16	4.00 EA
036	212-2875-501	ASSY,FAN,TT ILLUM	1.00 EA
037	212-2947-501	ASSY,SUPERVISOR	1.00 EA
038	212-2983-001	LABEL,INFO,TABLE TOP	1.00 EA
039	690-1121	LABEL,GROUND	1.00 EA
040	691-348	SPRING,COMP,.312ODX1.25L MW	4.00 EA
041	764-031	LATCH,ROTARY,.38 DIA ZINC	1.00 EA
042	773-056	RING,RETAINING,EXT .172 SHAFT	4.00 EA
043	773-073	RING,RETAINING,.250X.027 EXT	1.00 EA
044	781-305	SCREW,BTN HD,.25X.20X.62 CS	2.00 EA
045	796-060	WASHER,FLAT,.209X.438X.010	8.00 EA
046	797-063	WASHER,EXT LOCK.17X.38X.02	5.00 EA
047	800-004	WASHER,SPLITLOCK,M4	4.00 EA
048	800-204	WASHER,INT LOCK,M4	1.00 EA
049	801-004	WASHER,FLAT,M4	4.00 EA
050	803-004	NUT,HEX,M4X0.7	1.00 EA
051	805-425	SETSCREW.SKT HD,FLT M4X4	1.00 EA
052	807-014	SCREW,CAP HD SKT,M4X10	11.00 EA
053	807-022	SCREW,CAP HD SKT,M4X45	4.00 EA
054	807-042	SCREW,CAP HD SKT,M6X12	3.00 EA
055	809-006	SCREW,BTN HD SKT,M4X8	11.00 EA
056	809-007	SCREW,BTN HD SKT,M4X10	2.00 EA
057	809-008	SCREW,BTN HD SKT,M4X12	2.00 EA
058	809-103	SCREW,BTN HD SKT,M4X6	4.00 EA
059	811-002	SCREW,FLAT HD SKT,M3X8	2.00 EA
062	825-020	SCREW,CAP HD SKT,M4X35	2.00 EA
063	212-3088-001	LABEL,CAUTION,CONSTELLATION	1.00 EA
065	592-048	LABEL,WINDOWS,XP EMBEDDED	1.00 EA



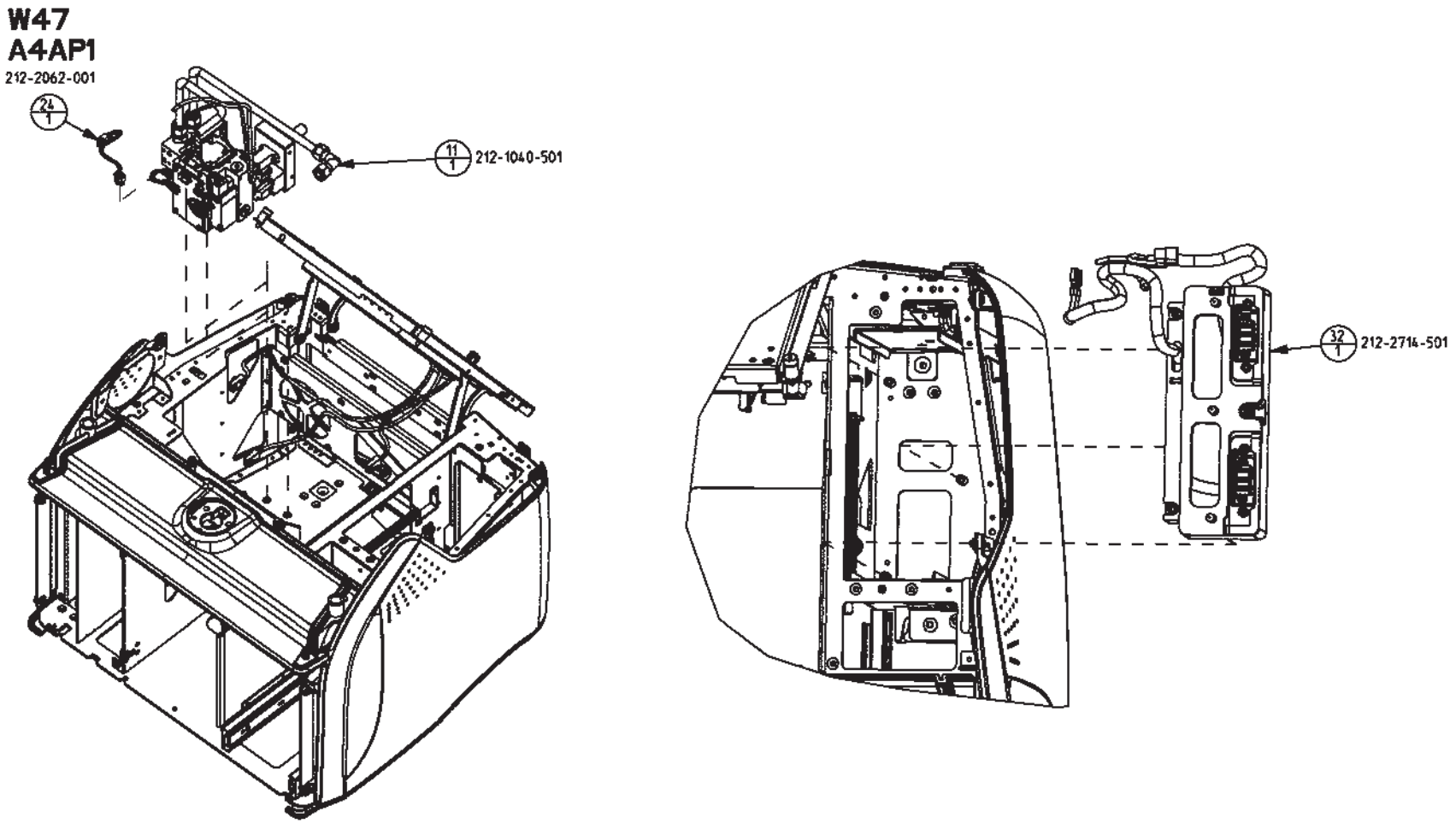
212-5002-501 **ASSY, TABLE TOP (1 of 12)**



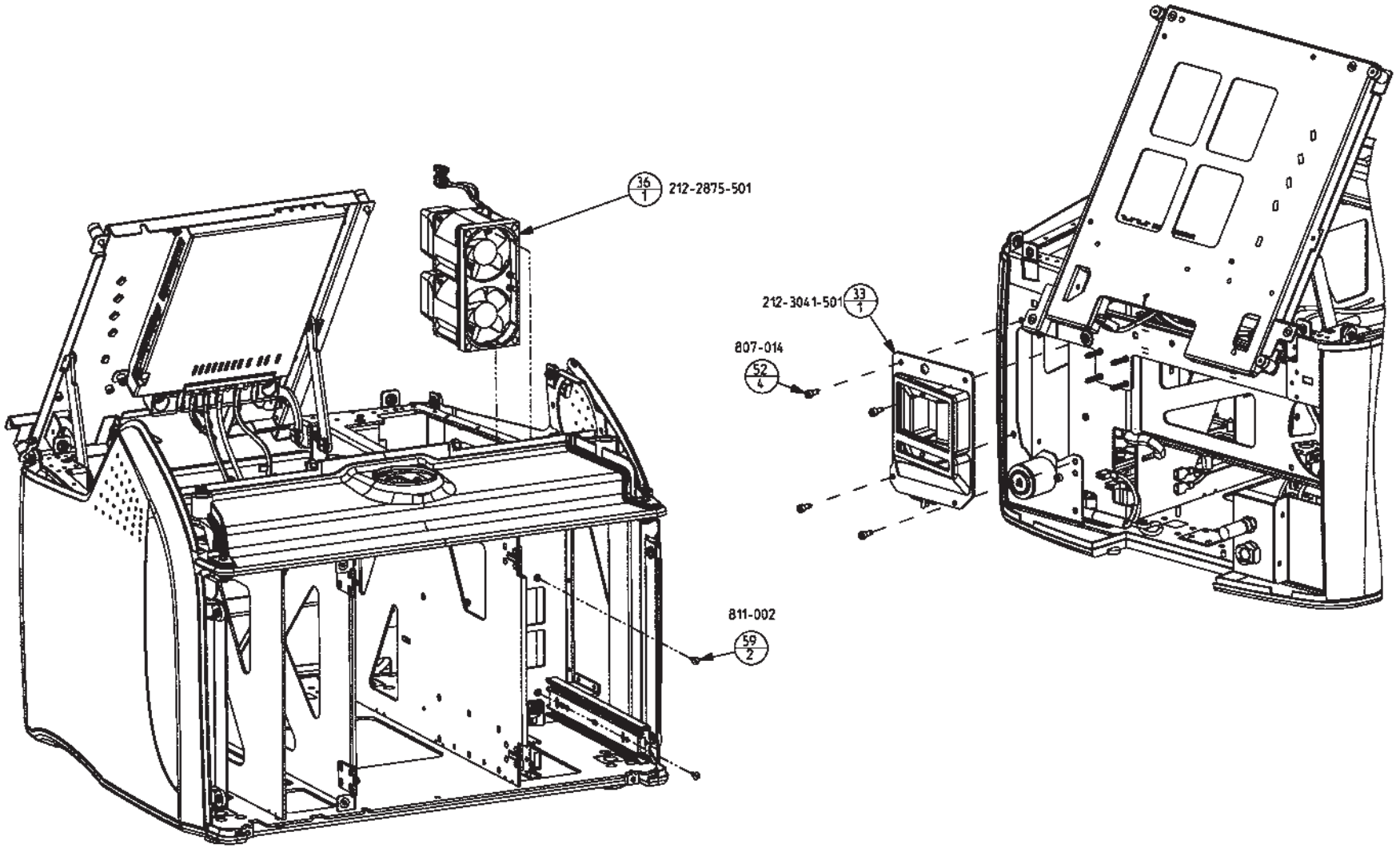
212-5002-501 **ASSY, TABLE TOP (2 of 12)**



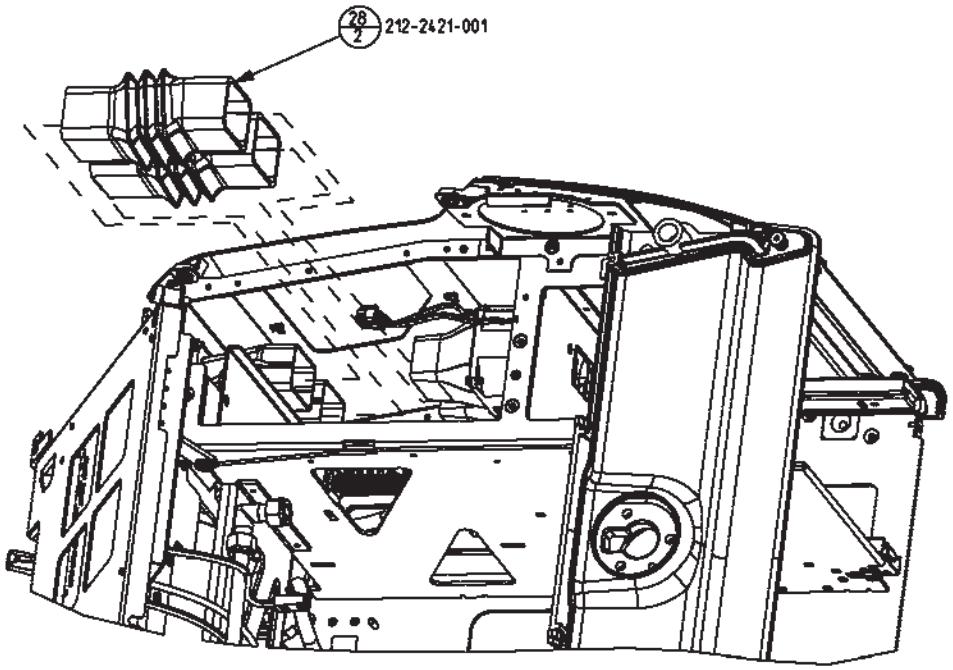
212-5002-501 **ASSY, TABLE TOP (3 of 12)**

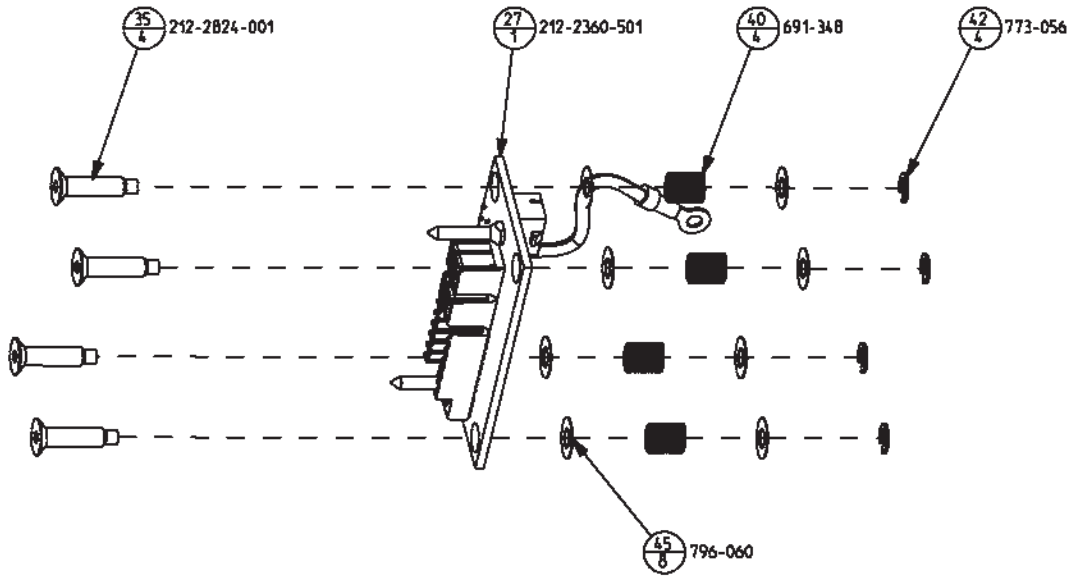


212-5002-501 **ASSY, TABLE TOP (4 of 12)**

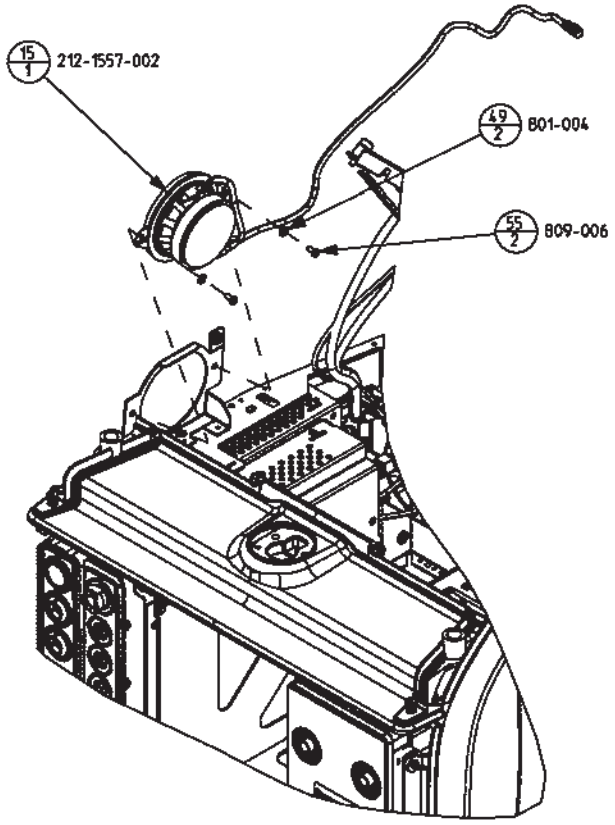


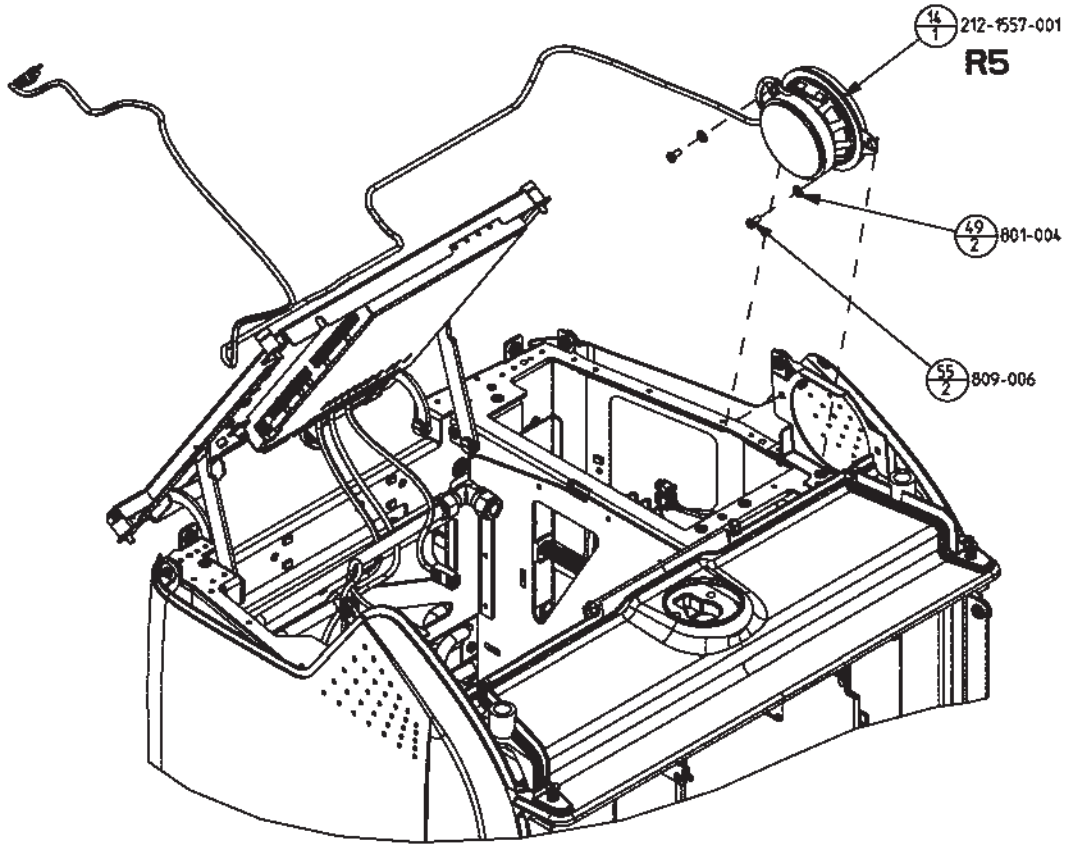
212-5002-501 **ASSY, TABLE TOP (5 of 12)**



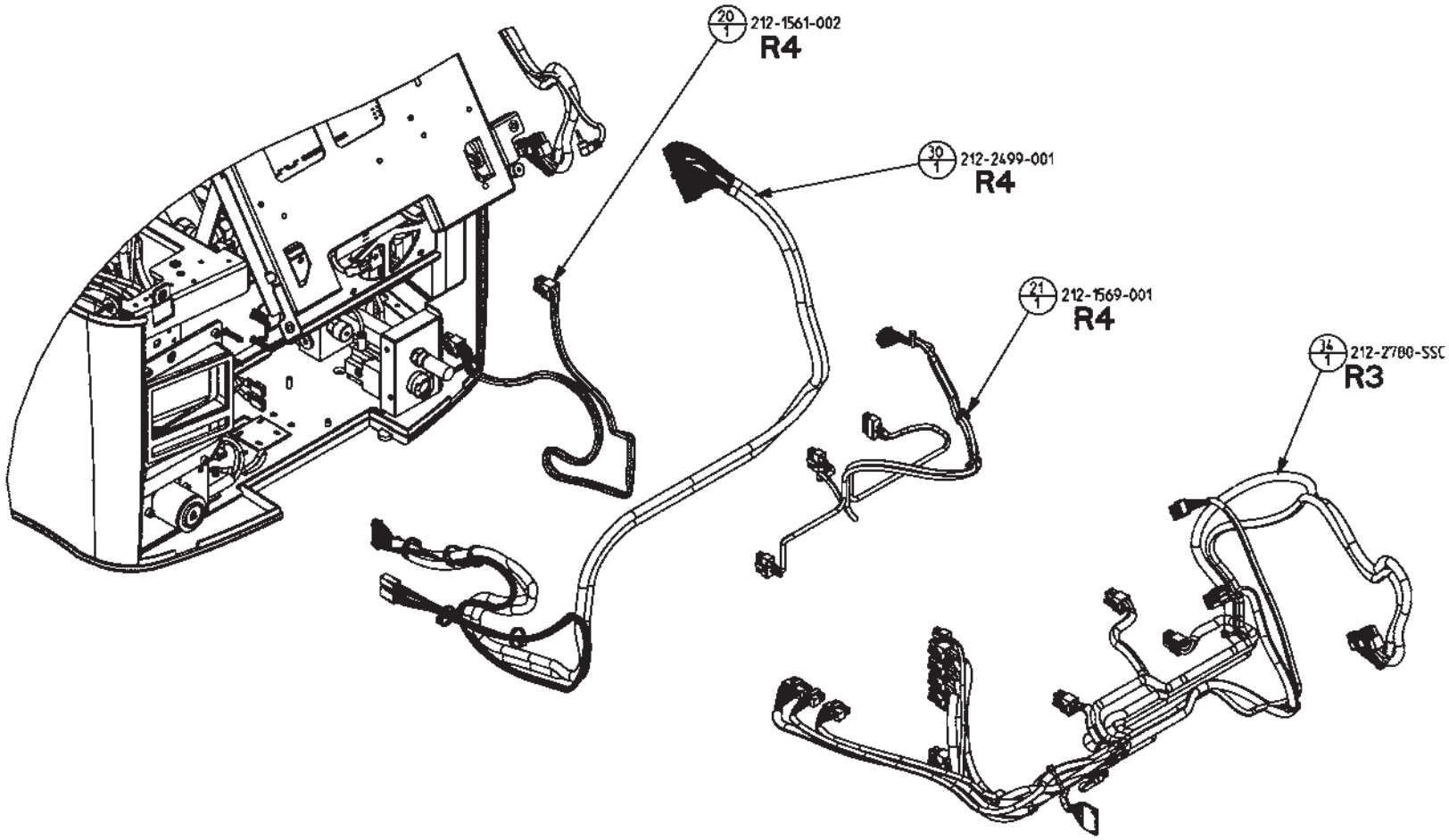


212-5002-501 **ASSY, TABLE TOP (6 of 12)**

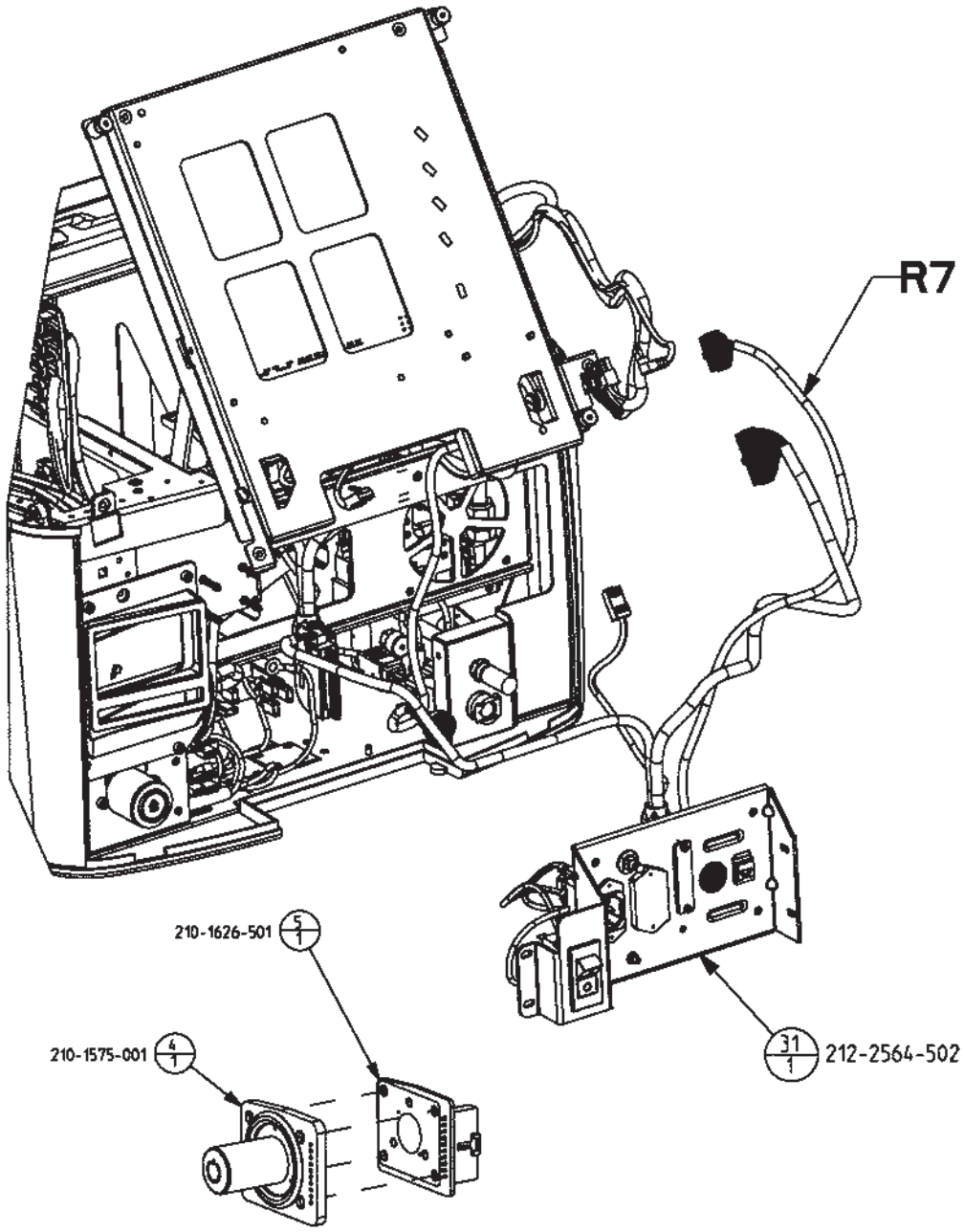


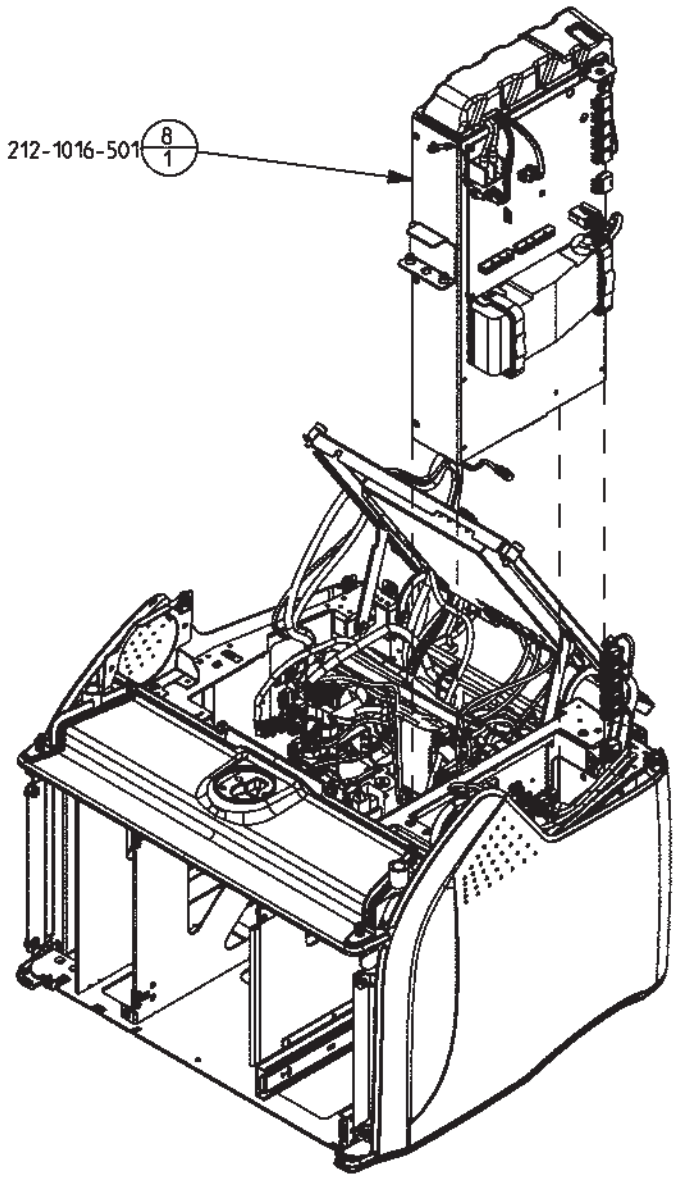


212-5002-501 **ASSY, TABLE TOP (7 of 12)**

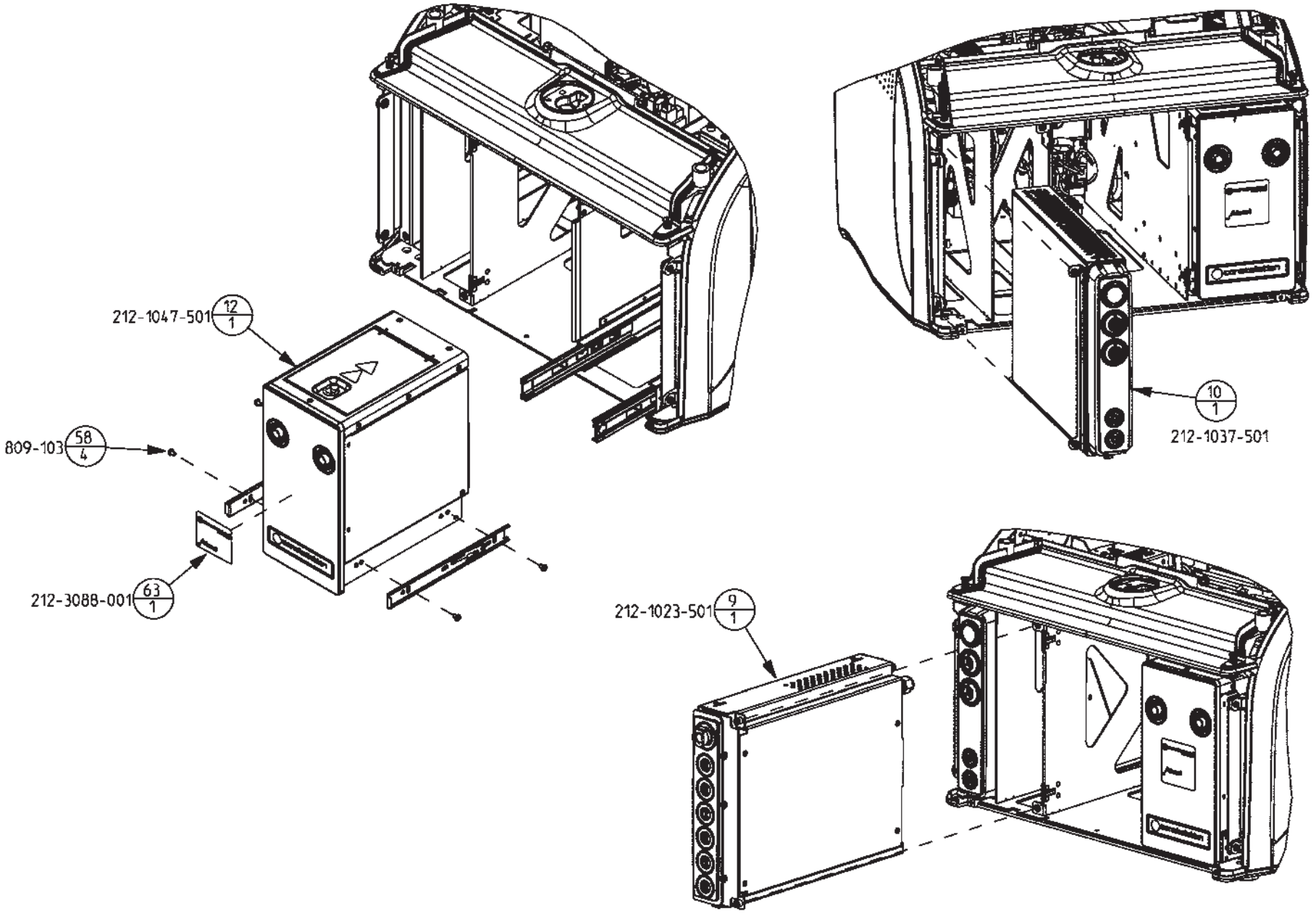


212-5002-501 **ASSY, TABLE TOP (8 of 12)**

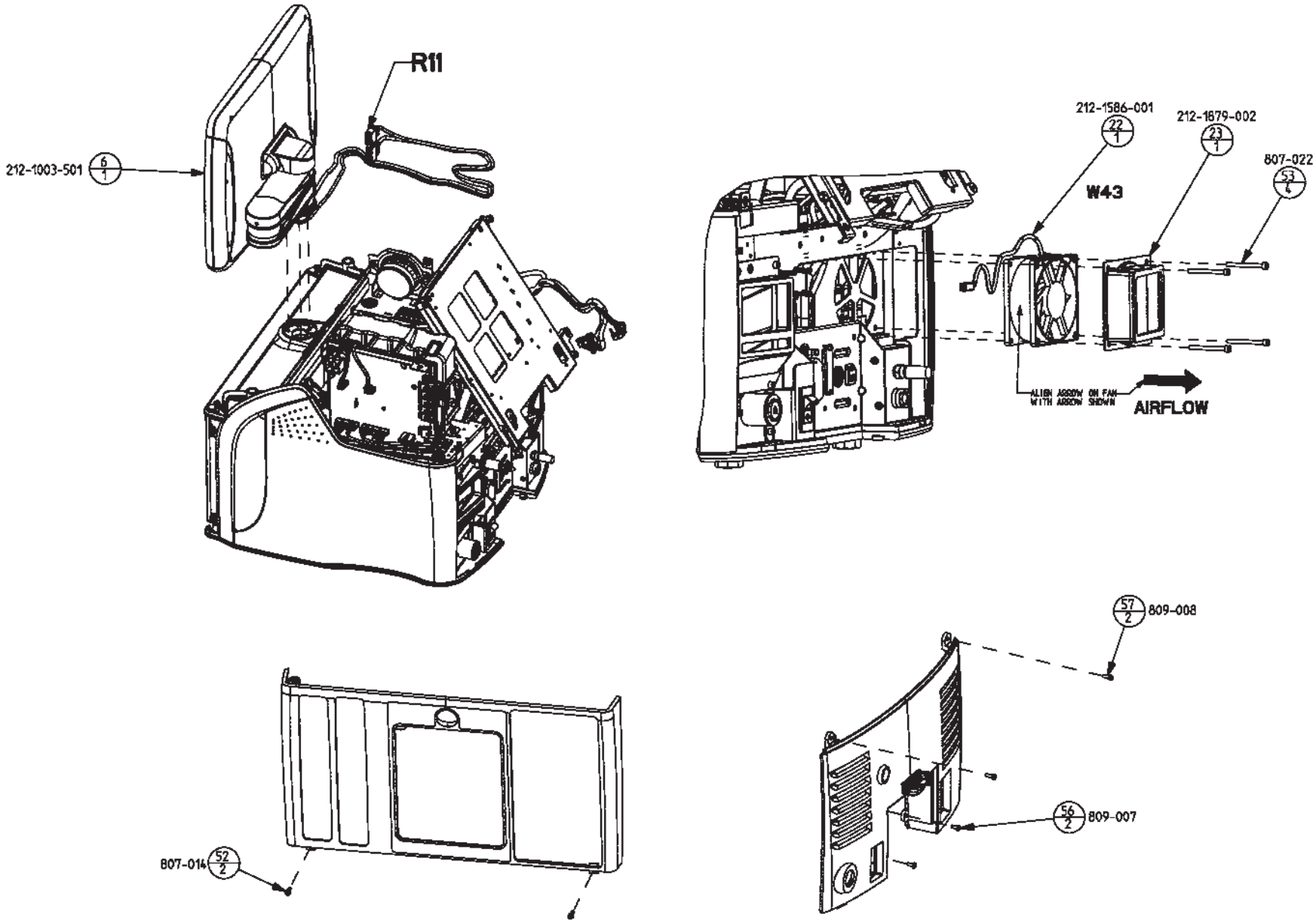




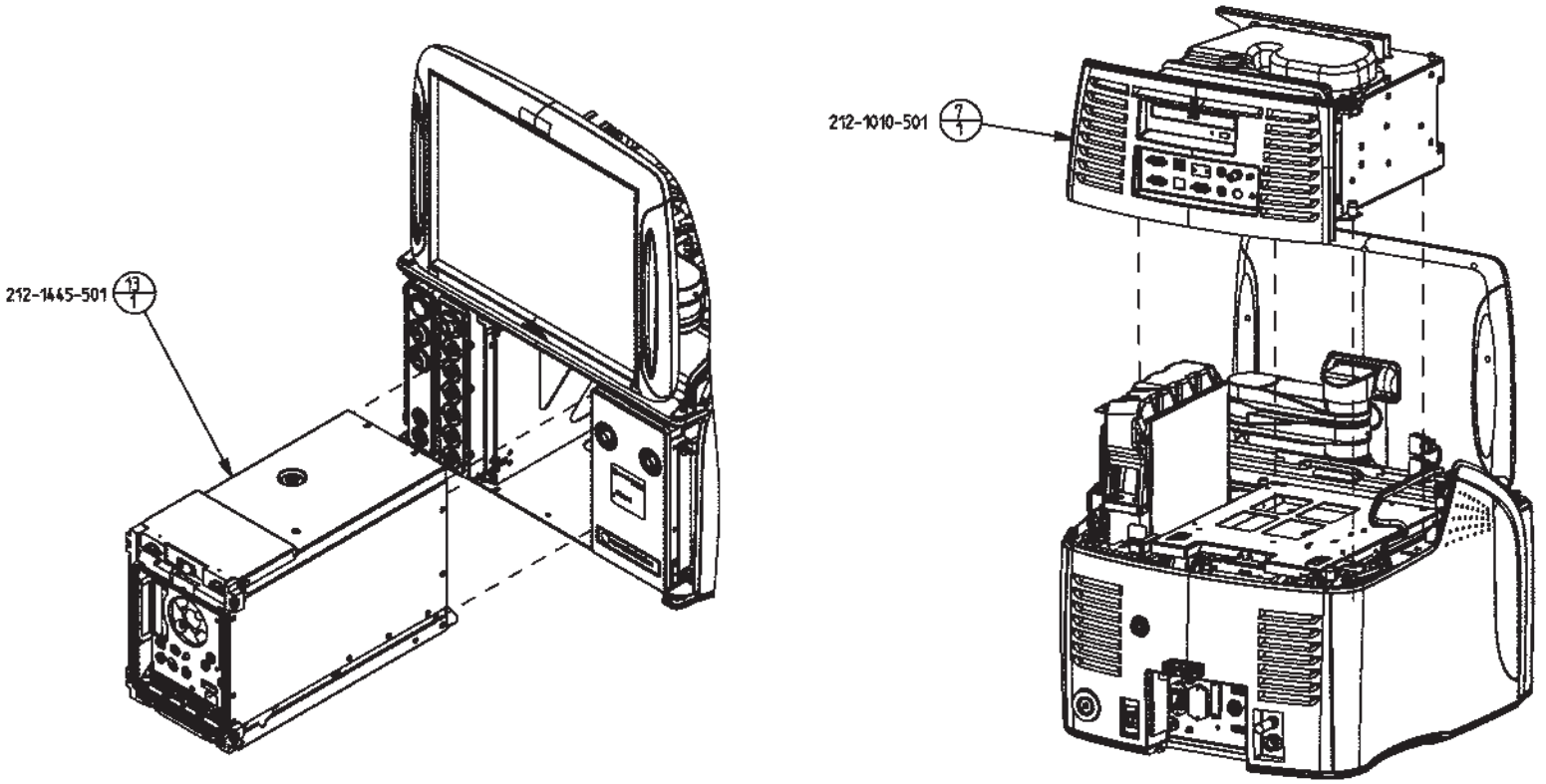
212-5002-501 **ASSY, TABLE TOP (9 of 12)**



212-5002-501 **ASSY, TABLE TOP (10 of 12)**



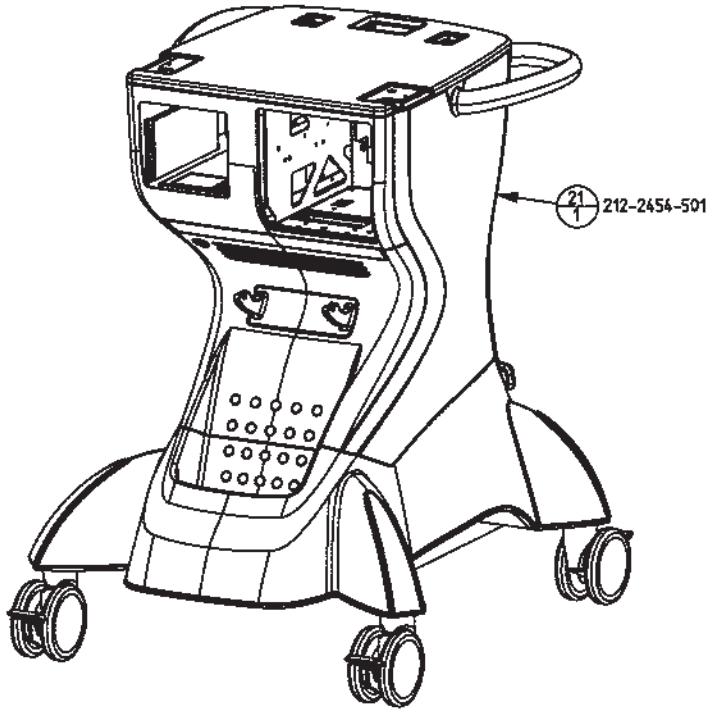
212-5002-501 **ASSY, TABLE TOP (11 of 12)**



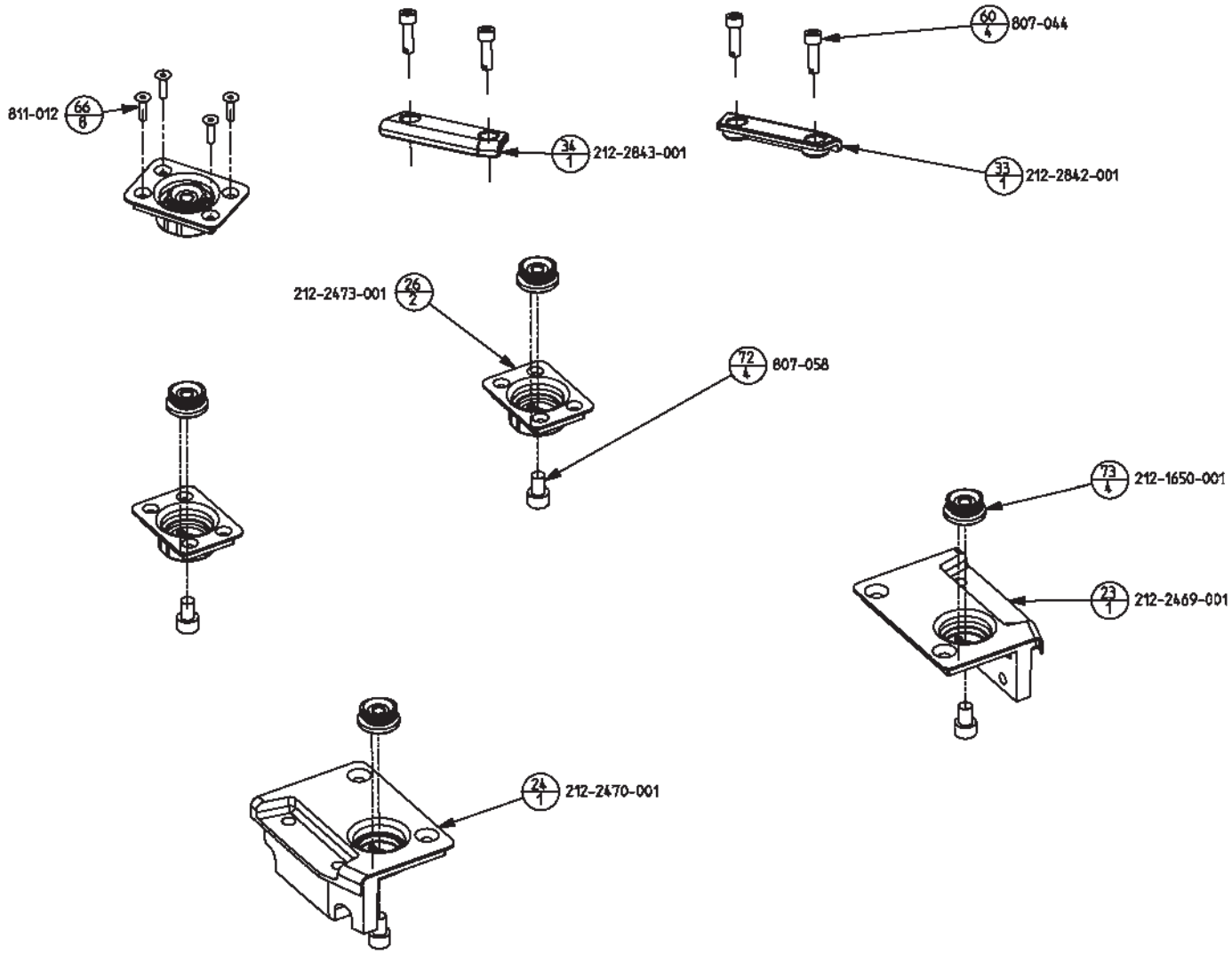
212-5002-501 **ASSY, TABLE TOP (12 of 12)**

constellation VISION SYSTEM

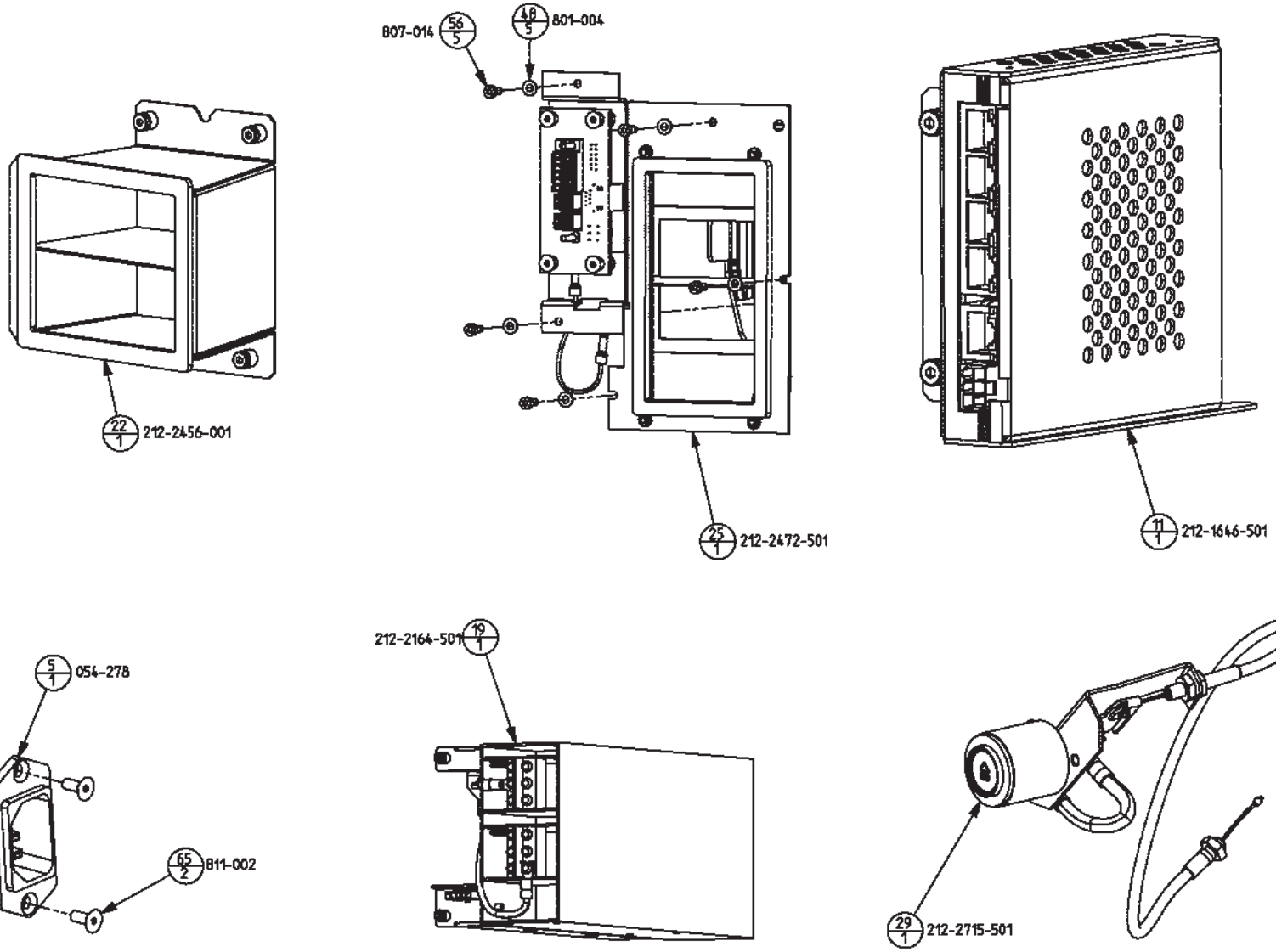
ITEM	PART#	DESCRIPTION	QTY
	212-5003-501	**ASSY, BASE UNIT, PREMIUM**	
001	023-084	CABLE ASSY,PWR CORD,12FT	1.00 EA
002	026-030	CLAMP,CABLE,.312 DIA NYLON	1.00 EA
003	027-003	CABLE TIE,.625X3.50L,NYLON	7.00 EA
004	027-009	CABLE TIE,3.00X11.00L,NYLON	9.00 EA
005	054-278	CONNECT,AC POWER,3 PRONG	1.00 EA
006	070-000	POST,BINDING,M6X15 BRS/NKL	1.00 EA
007	212-1007-501	ASSY,LASER	1.00 EA
008	212-1008-501	ASSY,ILLUMINATOR,AUX	1.00 EA
009	212-1561-009	CABLE ASSY,24V,DC W10	1.00 EA
010	212-1642-002	GROMMET,INTERCONNECT,CUT	1.00 EA
011	212-1646-501	ASSY,BASE,SWITCH	1.00 EA
012	212-1678-001	CABLE ASSY,FOOTSWITCH,W01	1.00 EA
013	212-1727-501	ASSY,PCB,INTERFACE BREAKOUT	1.00 EA
014	212-1957-001	DUCT,INTERFACE,NGL	1.00 EA
015	212-1959-001	BRACKET,REAR,INTERFACE CONN	1.00 EA
016	212-1996-001	CABLE ASSY,NGL,REAR INTF	1.00 EA
017	212-2019-001	CABLE ASSY,GROUND•EQUI W12	1.00 EA
018	212-2048-501	ASSY,PANEL,LASER REAR CART	1.00 EA
019	212-2164-501	ASSY,POWER DISTRIBUTION,CART	1.00 EA
020	212-2342-501	ASSY,BRACKET,UPPER CYL MTG	1.00 EA
021	212-2454-501	ASSY,BASE,UNIT	1.00 EA
022	212-2456-001	DUCT,OUTER,AUX ILLUM	1.00 EA
023	212-2469-001	BRACKET,TRAY ARM,MACHINED	1.00 EA
024	212-2470-001	BRACKET,IV POLE,MACHINED	1.00 EA
025	212-2472-501	ASSY,PANEL, DUCT AUX ILLUM	1.00 EA
026	212-2473-001	BRACKET,FOOT,TOP REAR	2.00 EA
027	212-2543-001	WASHER,TAPERED,PCBA	4.00 EA
028	212-2665-501	ASSY,PCB,INTERFACE EXTENDER	1.00 EA
029	212-2715-501	ASSY,ACTUATOR,LATCH ILLUM	1.00 EA
030	212-2781-SSC	KIT,SSC,HARN ASSY BOT CNSL	1.00 EA
031	212-2832-001	CABLE ASSY,GROUND,W37	1.00 EA
032	212-2833-001	CABLE ASSY,GROUND,W38	1.00 EA
033	212-2842-001	COVER,BRACKET,TRAY ARM RT	1.00 EA
034	212-2843-001	COVER,BRACKET,TRAY ARM LT	1.00 EA
036	690-1121	LABEL,GROUND	1.00 EA
037	691-347	SPRING,CPRSN,.328ODX1.250 MW	4.00 EA
038	767-097	NUT,HEX,4-40X.217X.066	2.00 EA
039	796-131	WASHER,FLAT,.228X.437X.030	4.00 EA
040	796-137	WASHER,FLAT,.218X.375X.062 NYL	4.00 EA
041	797-017	WASHER,SPLT LK,.19X.33X.05	2.00 EA
042	797-022	WASHER,SPLT LK,.25X.49X.06	1.00 EA
043	797-064	WASHER,EXT LOCK.20X.41X.03	5.00 EA
044	797-065	WASHER,EXT LOCK.26X.51X.03	1.00 EA
045	798-340	WASHER,SHLDR,NO.6 .125 LG	2.00 EA
046	800-103	WASHER,EXT LOCK,M3	4.00 EA
047	801-003	WASHER,FLAT,M3	4.00 EA
048	801-004	WASHER,FLAT,M4	7.00 EA
049	801-006	WASHER,FLAT,M6	6.00 EA
050	801-039	WASHER,GRN/YEL,.241ID X.655 OD	1.00 EA
051	803-006	NUT,HEX,M6X1	2.00 EA
052	805-425	SETSCREW.SKT HD,FLT M4X4	1.00 EA
053	807-002	SCREW,CAP HD SKT,M3X6	2.00 EA
054	807-004	SCREW,CAP HD SKT,M3X10	8.00 EA
055	807-013	SCREW,CAP HD SKT,M4X8	3.00 EA
056	807-014	SCREW,CAP HD SKT,M4X10	7.00 EA
057	807-015	SCREW,CAP HD SKT,M4X12	6.00 EA
058	807-017	SCREW,CAP HD SKT,M4X20	4.00 EA
059	807-043	SCREW,CAP HD SKT,M6X16	4.00 EA
060	807-044	SCREW,CAP HD SKT,M6X20	4.00 EA
063	809-007	SCREW,BTN HD SKT,M4X10	1.00 EA
064	809-103	SCREW,BTN HD SKT,M4X6	8.00 EA
065	811-002	SCREW,FLAT HD SKT,M3X8	2.00 EA
066	811-012	SCREW,FLAT HD SKT,M4X16	8.00 EA
067	811-032	SCREW,FLAT HD SKT,M6X16	4.00 EA
068	892-354	ADHESIVE,LOCTITE 2440 BLUE	.00 EA
069	212-2800-001	SLIDE,DRAWER,7.9LGX7.9	2.00 EA
070	212-2761-001	BRACKET,COVER,REAR	1.00 EA
071	212-2837-501	ASSY,PANEL,LASER REAR CART	1.00 EA
072	807-058	SCREW,CAP HD SKT,M8X12	4.00 EA
073	212-1650-001	CAP,BASE	4.00 EA
074	212-2568-002	FACEPLATE,NON LASER PAINTED	1.00 EA
075	212-2225-001	BRACKET,MOUNT,FRONT	1.00 EA



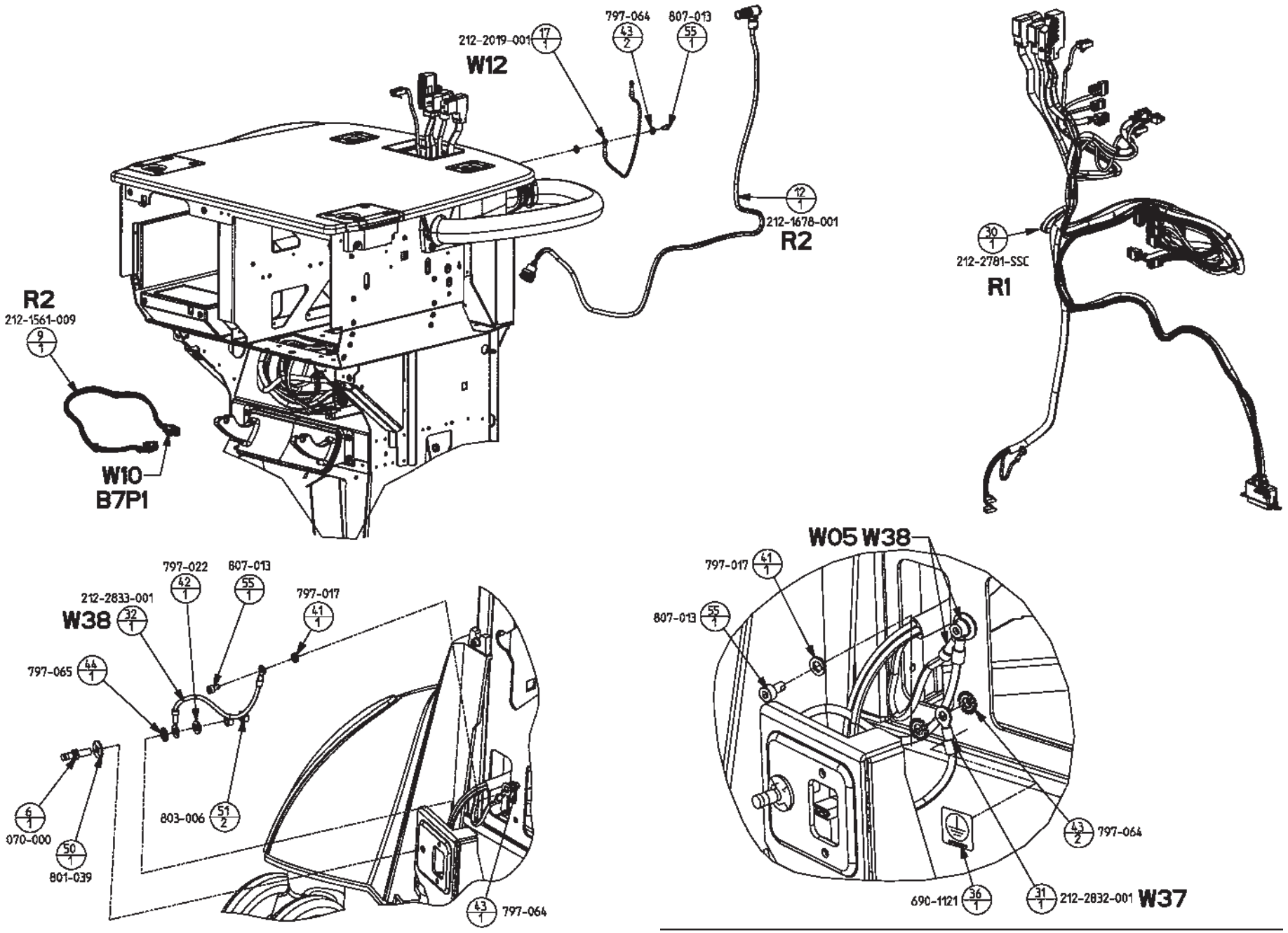
212-5003-501 ASSY, BASE UNIT, PREMIUM (1 of 7)



212-5003-501 ASSY, BASE UNIT, PREMIUM (2 of 7)



212-5003-501 ASSY, BASE UNIT, PREMIUM (3 of 7)



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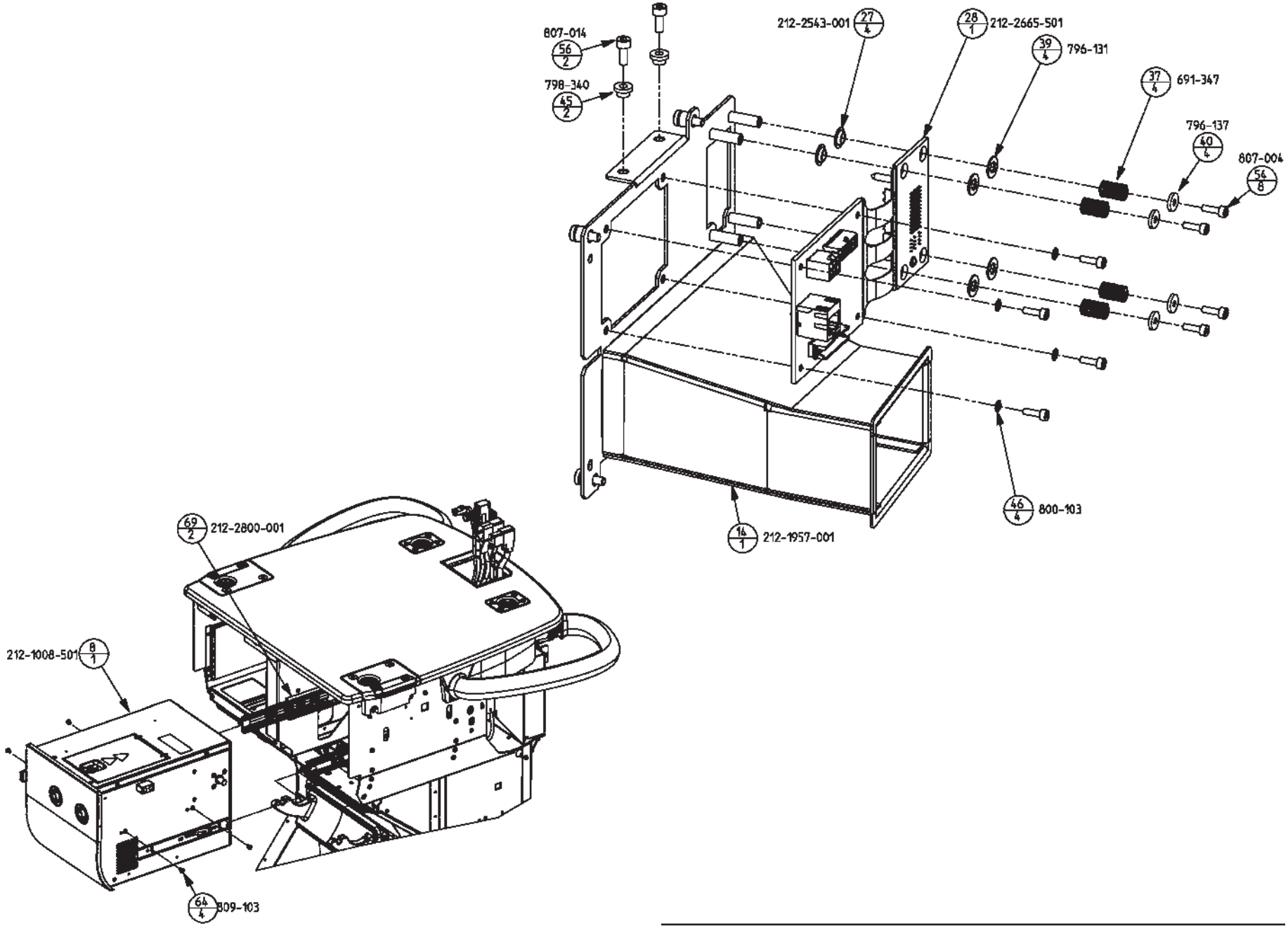
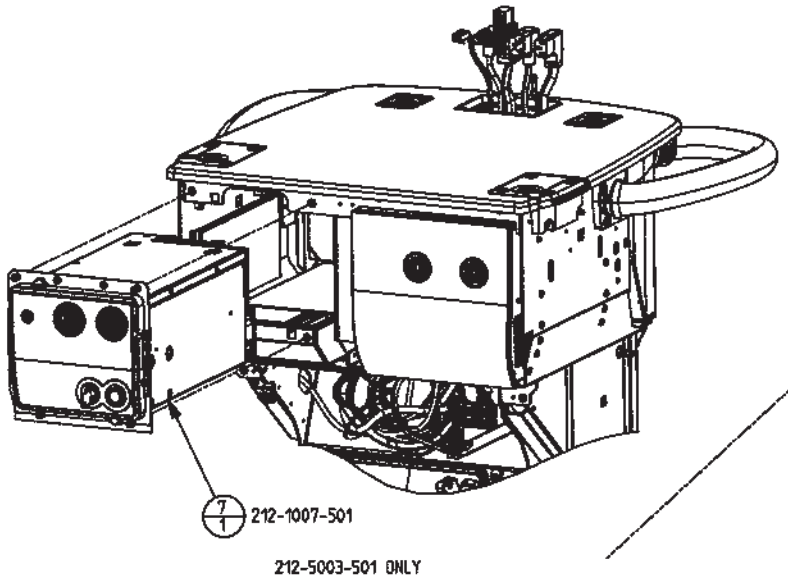


212-5003-501 ASSY, BASE UNIT, PREMIUM (5 of 7)



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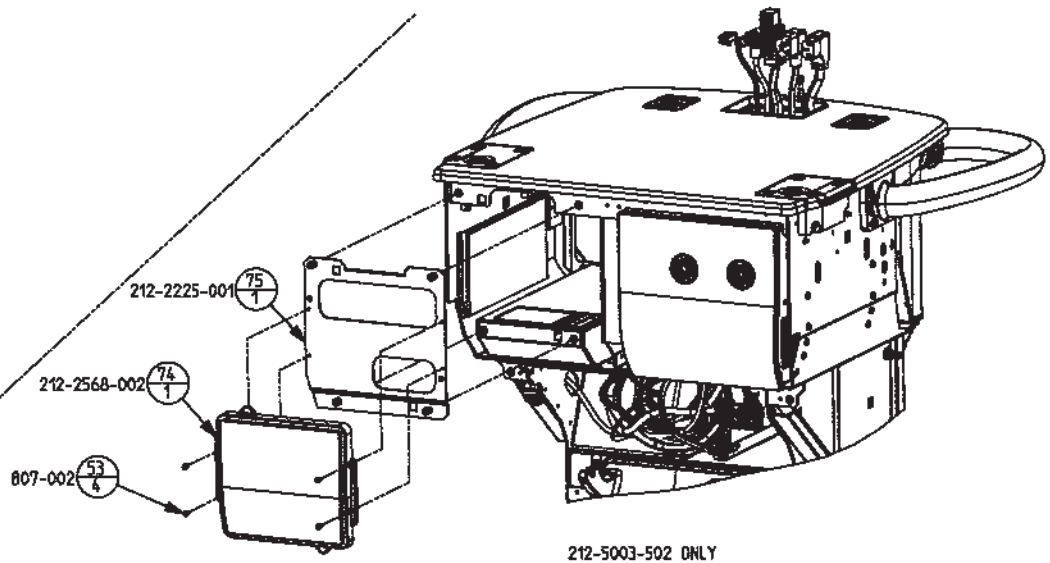

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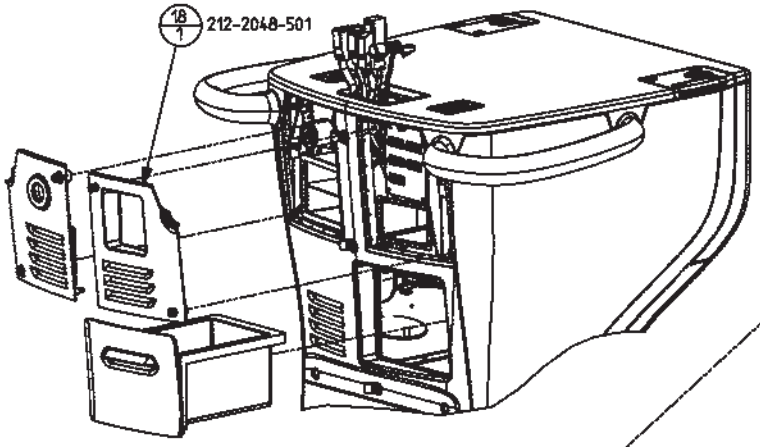

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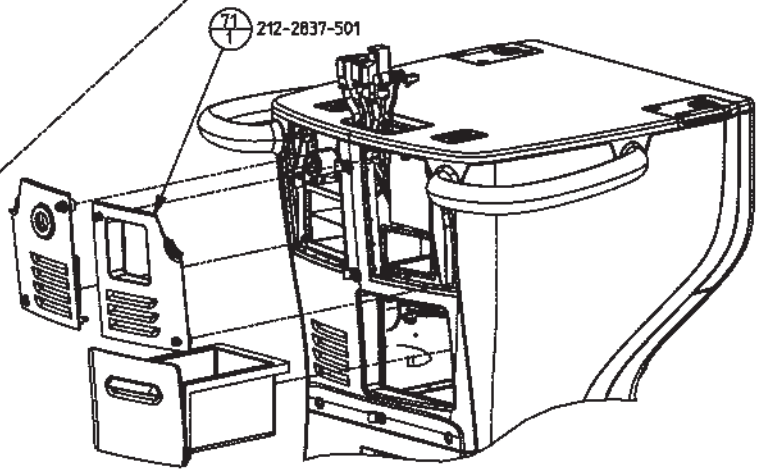
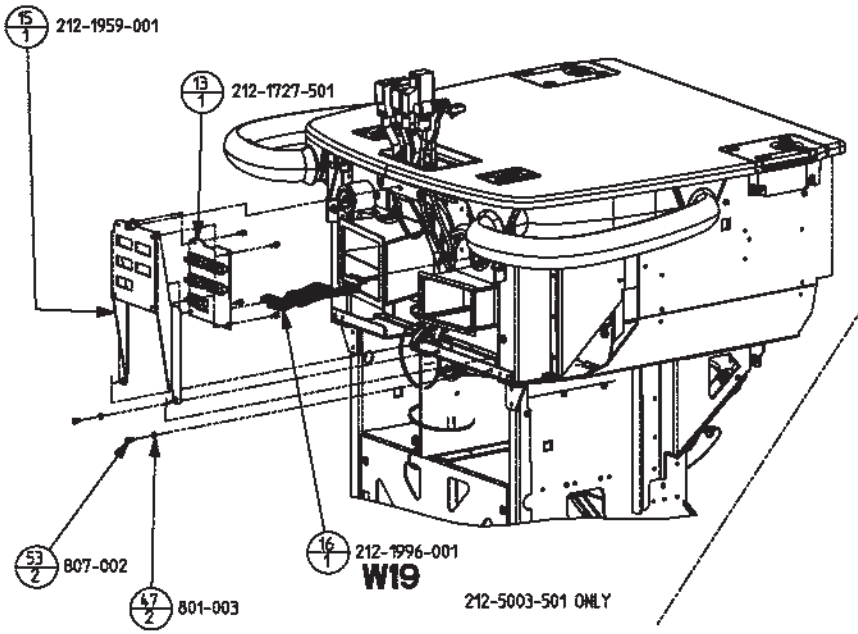
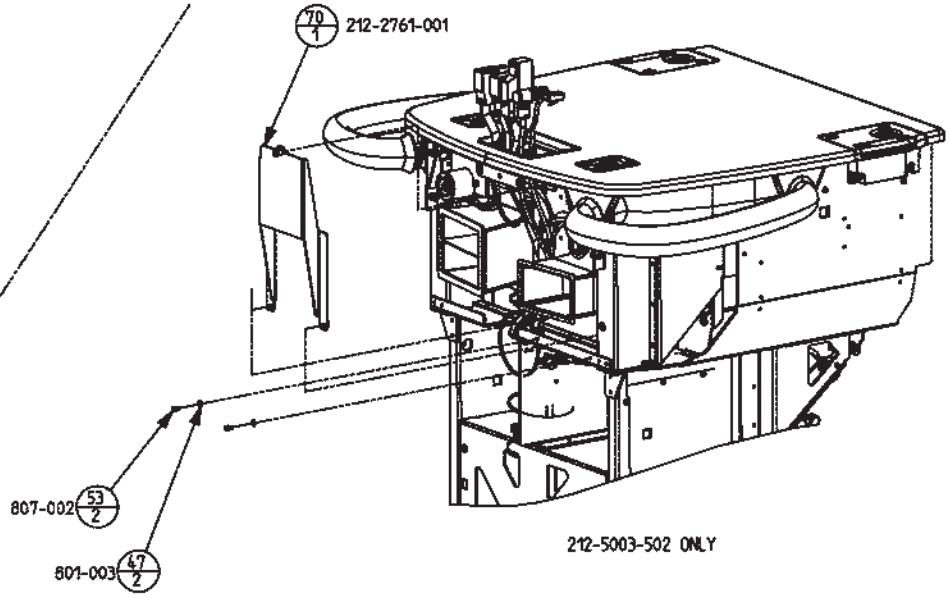
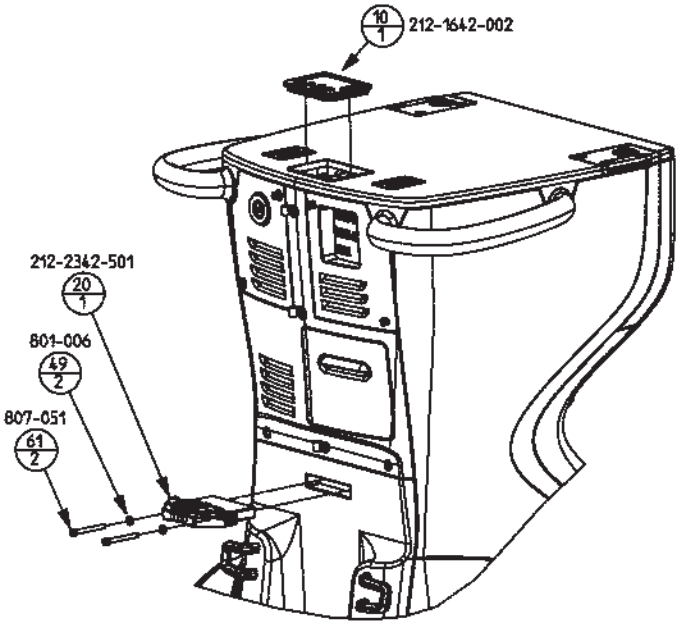


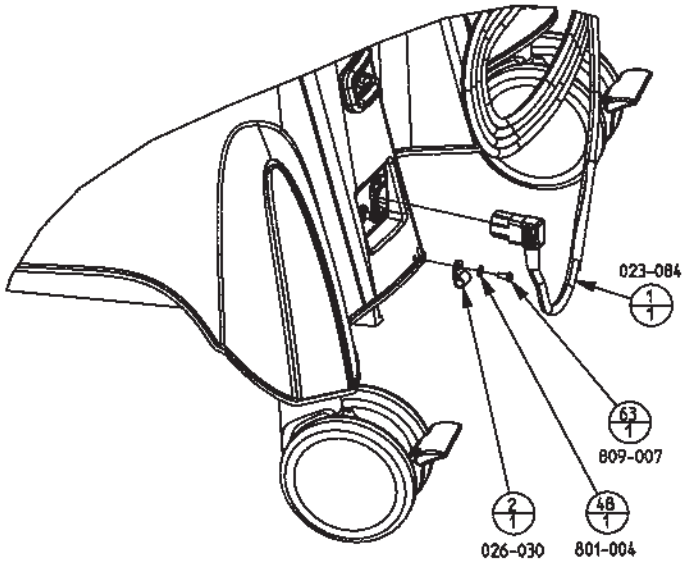
212-5003-502 ONLY

212-5003-501 ASSY, BASE UNIT, PREMIUM (6 of 7)





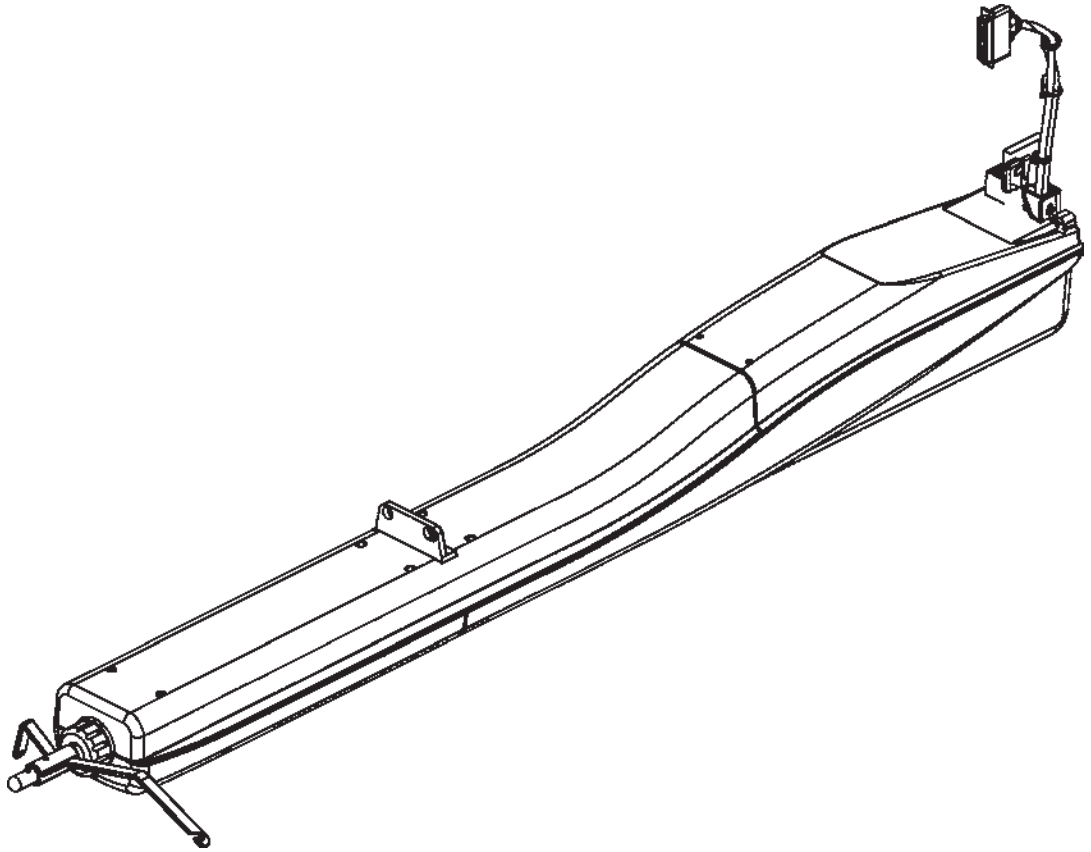




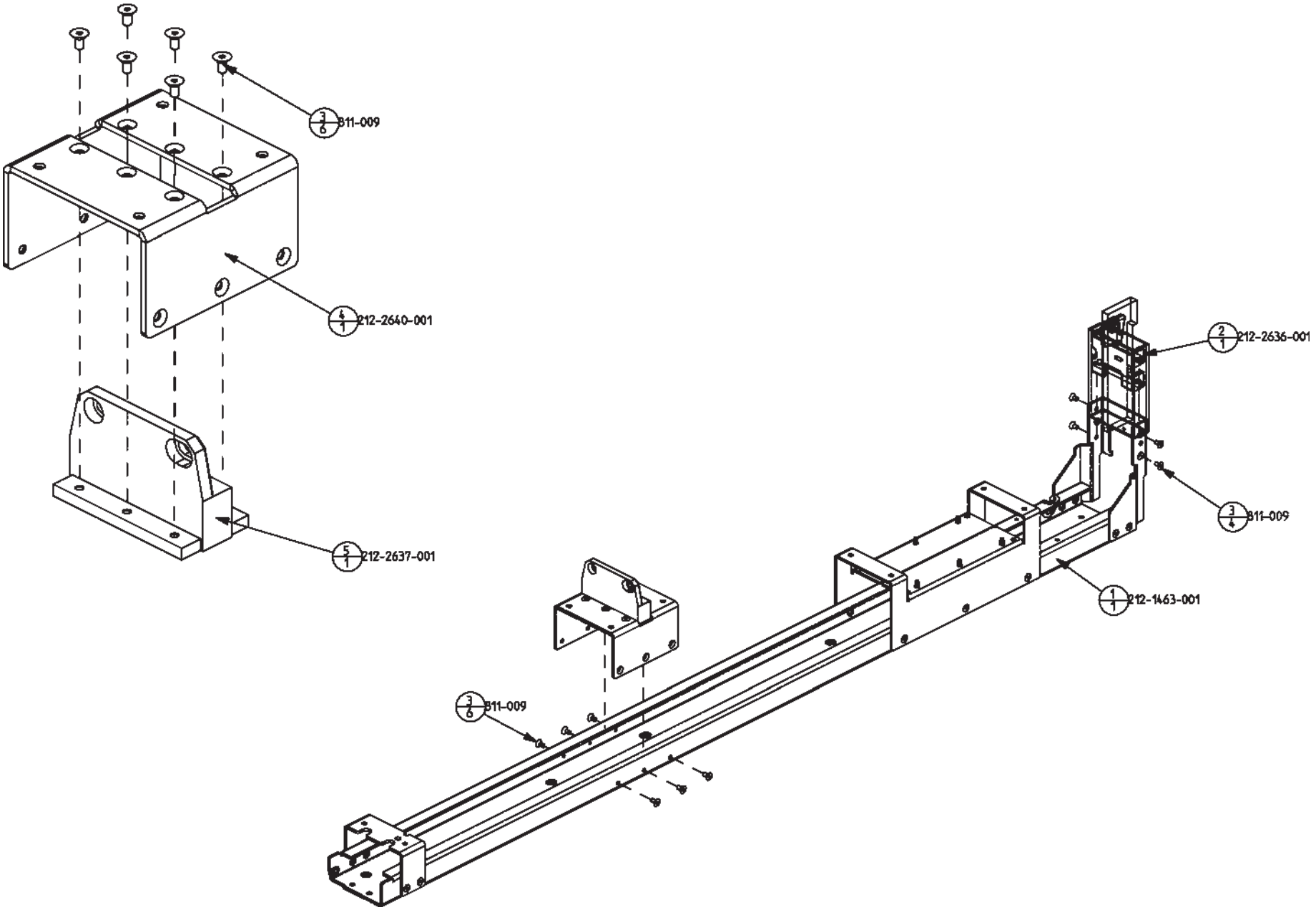
212-5003-501 ASSY, BASE UNIT, PREMIUM (7 of 7)

constellation VISION SYSTEM

ITEM	PART#	DESCRIPTION	QTY
	212-5004-501	**IV POLE**	
001	212-1463-001	FRAME,SUPPORT,IV POLE	1.00 EA
002	212-2438-001	BRACKET,IV POLE,LOW MOUNTING	1.00 EA
003	811-009	SCREW,FLAT HD SKT,M4X8 SST	23.0 EA
004	212-2640-001	BRACKET,MOUNTING	1.00 EA
005	212-2637-001	MOUNT,TOWER,UPPER	1.00 EA
006	212-1854-501	ASSY,CABLE,IV POLE SENSOR	1.00 EA
007	807-001	SCREW,CAP HD SKT,M3X5 SST	6.00 EA
008	026-091	CABLE,MOUNT,.75X.75 ABS WHT	4.00 EA
009	027-003	CABLE TIE,.625X3.50L,NYLON	7.00 EA
010	202-1726-001	GUIDE,NUT CARRIER,IV POLE	1.00 EA
011	202-1670-001	TARGET,SENSOR	1.00 EA
012	810-001	SCREW,BTN HD SKT,M3X6 BLK	2.00 EA
013	807-027	SCREW,CAP HD SKT,M5X12 SST	3.00 EA
014	691-250	SPRING,CPRSN,.31X.120 OD SST	1.00 EA
015	202-1760-001	PLATE,SLIDE CARRIER	1.00 EA
016	200-1744-001	GUIDE,FLANGE,BOTTOM	1.00 EA
017	811-020	SCREW,FLAT HD SKT,M5X12 SST	4.00 EA
018	202-1621-001	SCREW,LEAD,IV POLE	1.00 EA
019	202-1778-001	SLEEVE,LDSCRW END,ACCURUS	1.00 EA
020	773-034	RING,RETAINING,.303 SHAFT	1.00 EA
021	891-023	LUBRICANT,FLUOROCARBN GEL	.00 OZ
022	202-1620-001	POLE,IV,ACCURUS	1.00 EA
023	805-052	SETSCREW,SKT HD,FLT M5X10	1.00 EA
025	200-1743-001	GUIDE,FLANGE,IV POLE	1.00 EA
026	200-1746-001	PLATE,MOUNTING,I/V POLE	1.00 EA
027	593-069	TAPE,VINYL,PRES-BOND .60 WIDE	.00 FT
028	212-2486-001	MOTOR ASSY,IV POLE,W/BRAKE	1.00 EA
029	716-024	PULLEY,TIMING,12 GROOVE	1.00 EA
030	805-029	SETSCREW,SKT HD,FLT M3X3	2.00 EA
031	892-042	ADHESIVE,THREADLOCKER,242	.00 ML
032	701-019	BELT,TIMING,.20 PITCH X9 CRCMF	1.00 EA
033	716-023	PULLEY,TIMING,36GROOVE	1.00 EA
034	805-050	SETSCREW,SKT HD,FLT M5X6 SST	2.00 EA
035	212-1481-501	ASSY,PCB,IV POLE	1.00 EA
036	212-1853-501	ASSY,CABLE,IV POLE INTERFACE	1.00 EA
037	212-2020-001	COVER,PCB,IV POLE	1.00 EA
038	212-1651-001	COVER,LOWER	1.00 EA
039	212-1483-002	PANEL,LOWER OUTER,POLE	1.00 EA
040	807-012	SCREW,CAP HD SKT,M4X6 SST	10.0 EA
041	212-1485-002	PANEL,UPPER OUTER,IV POLE	1.00 EA
042	212-1657-001	SWITCH,IV POLE	1.00 EA
043	212-1893-001	GASKET,TOP,IV POLE	1.00 EA
044	212-1484-002	PANEL,POLE,UPR INR TRAY PTD	1.00 EA
045	807-014	SCREW,CAP HD SKT,M4X10 SST	8.00 EA
046	212-1482-002	PANEL,LOWER INNER,POLE	1.00 EA
047	212-1894-001	GASKET,BOTTOM,IV POLE	1.00 EA
048	807-016	SCREW,CAP HD SKT,M4X16 SST	2.00 EA
049	212-1809-001	CAP,IV POLE	1.00 EA
050	212-1673-001	HANGER ASSY,IV POLE	1.00 EA
051	805-038	SETSCREW,SKT HD,FLT M4X3 SST	1.00 EA



212-5004-501 **ASSY, IV POLE (1 of 9)**



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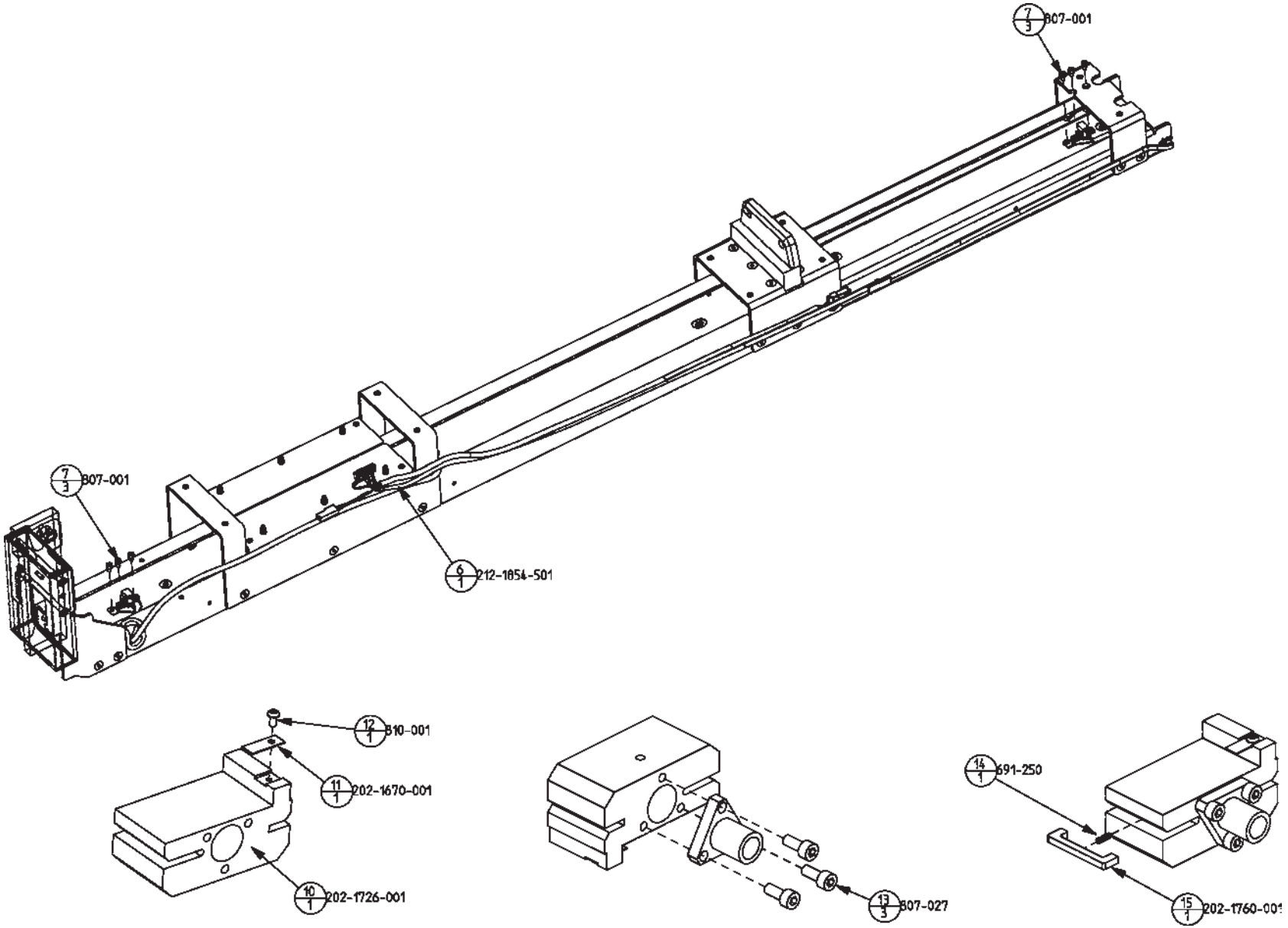
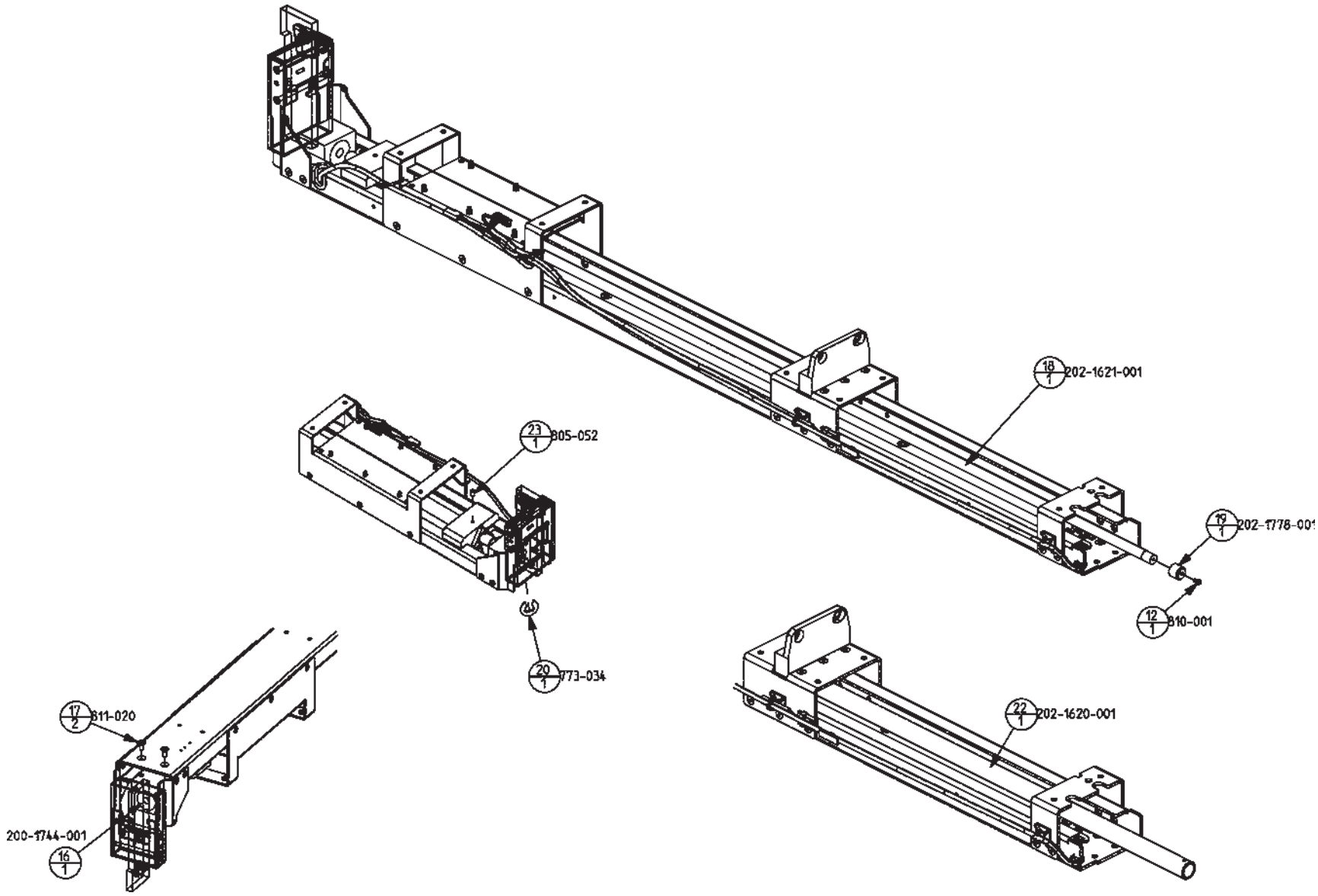
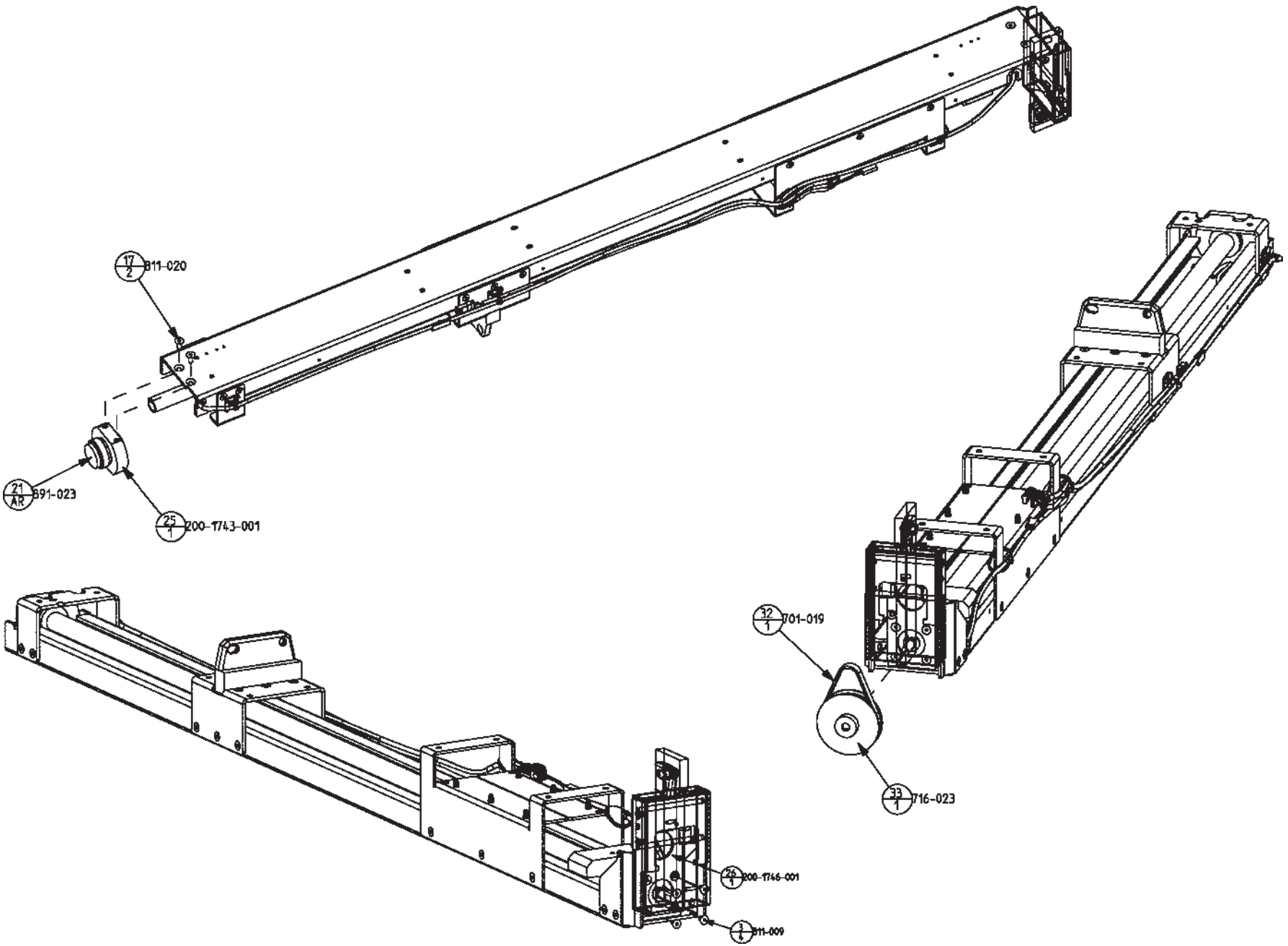


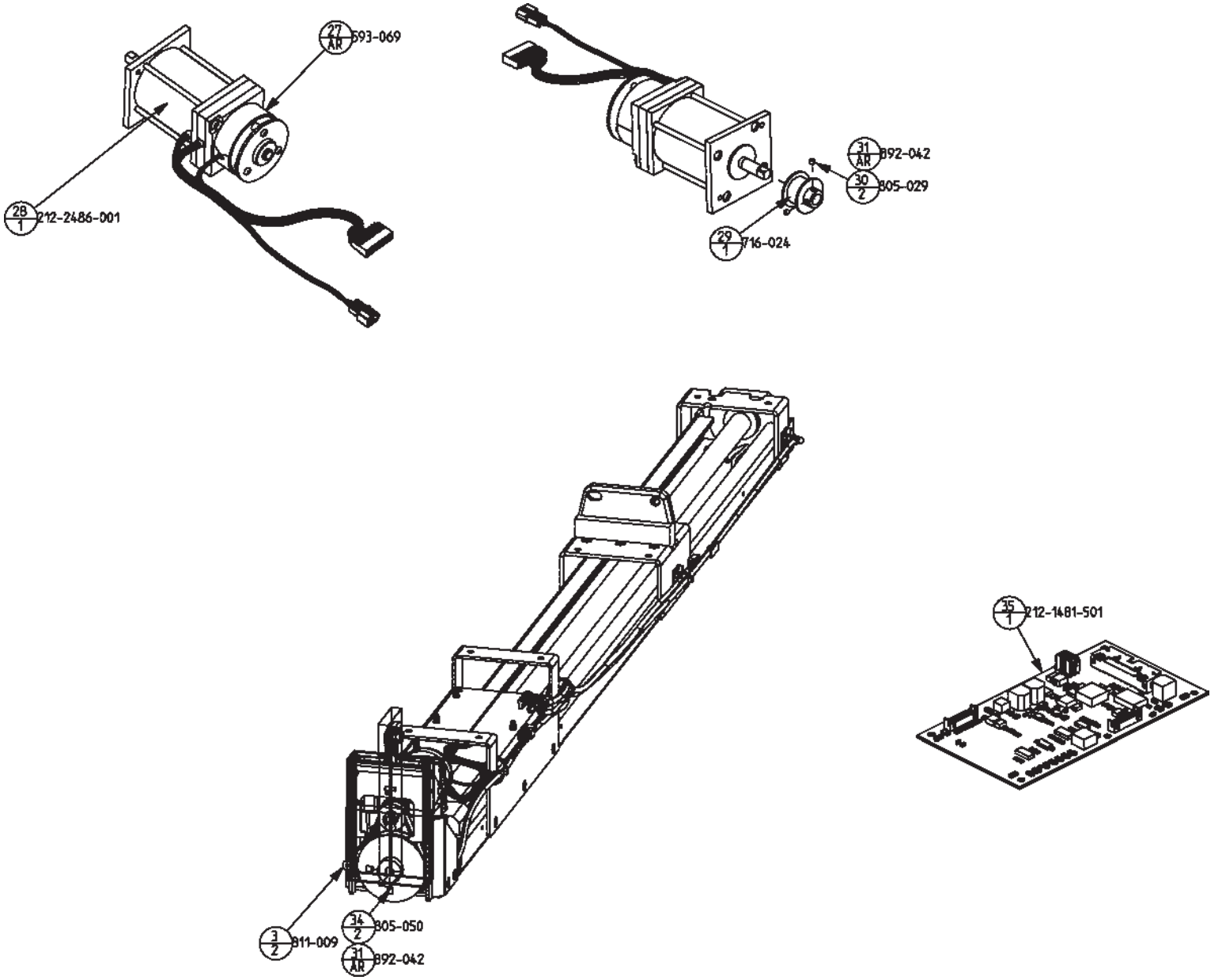
212-5004-501 **ASSY, IV POLE (3 of 9)**



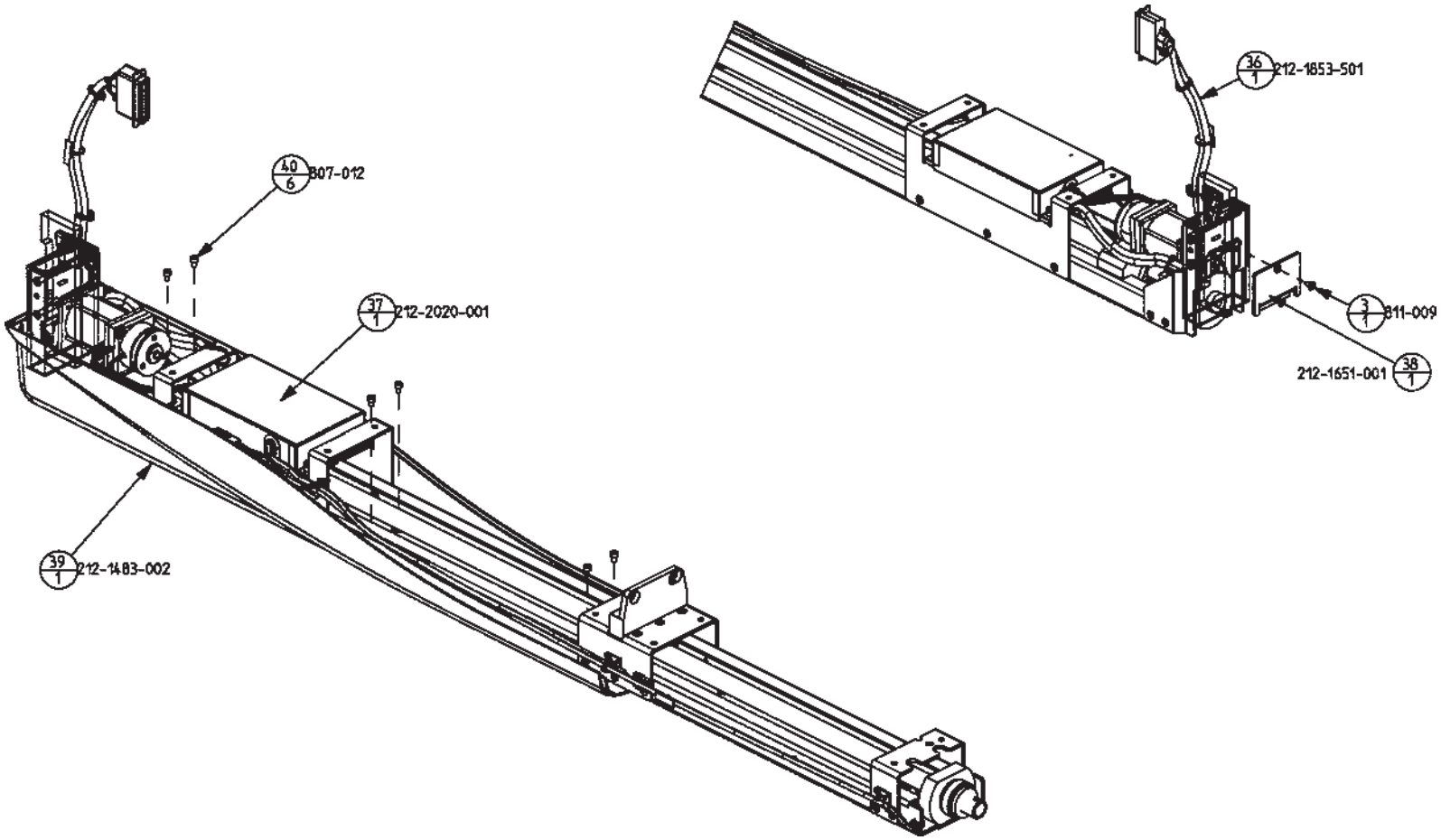
212-5004-501 **ASSY, IV POLE (4 of 9)**



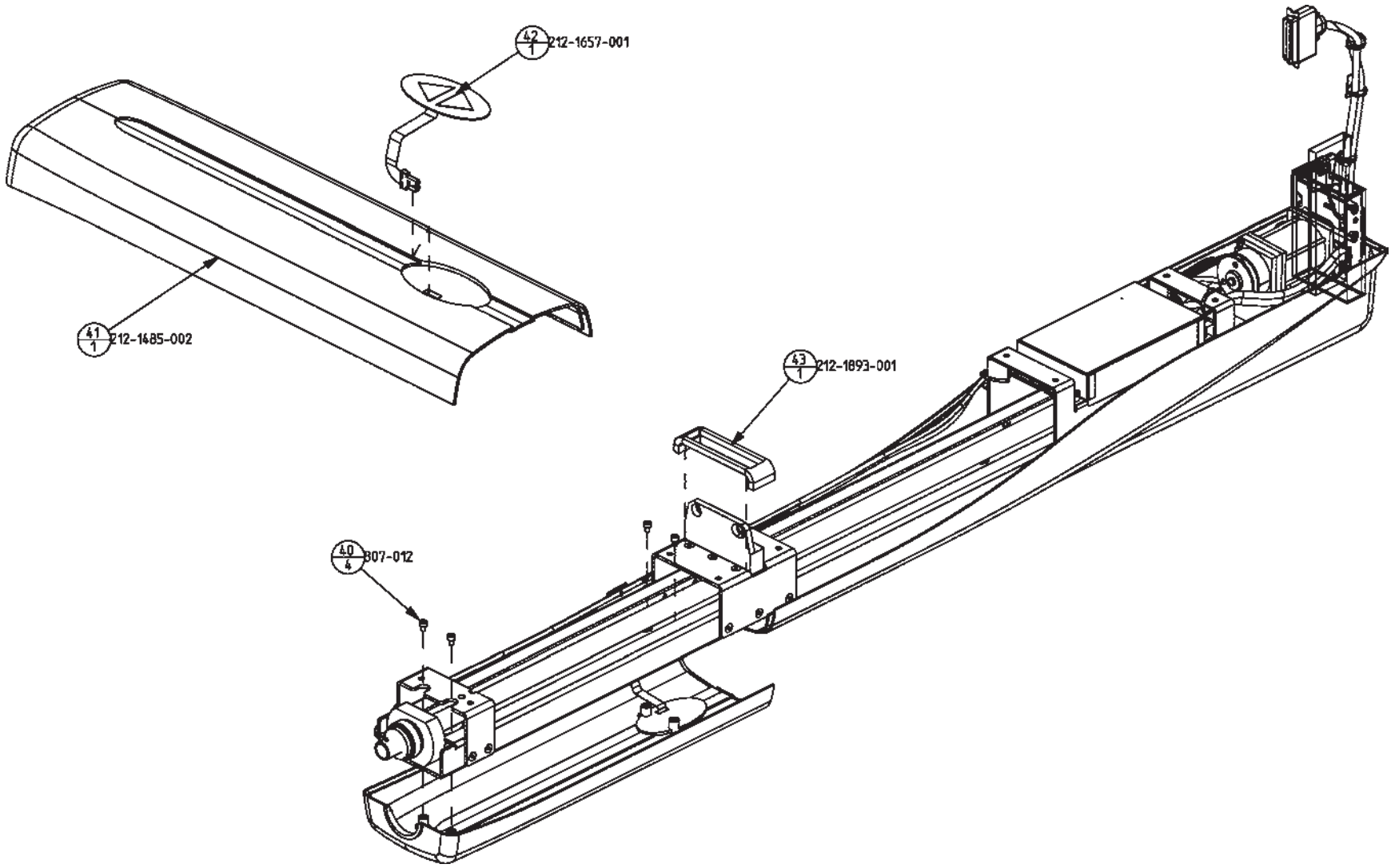
212-5004-501 **ASSY, IV POLE (5 of 9)**



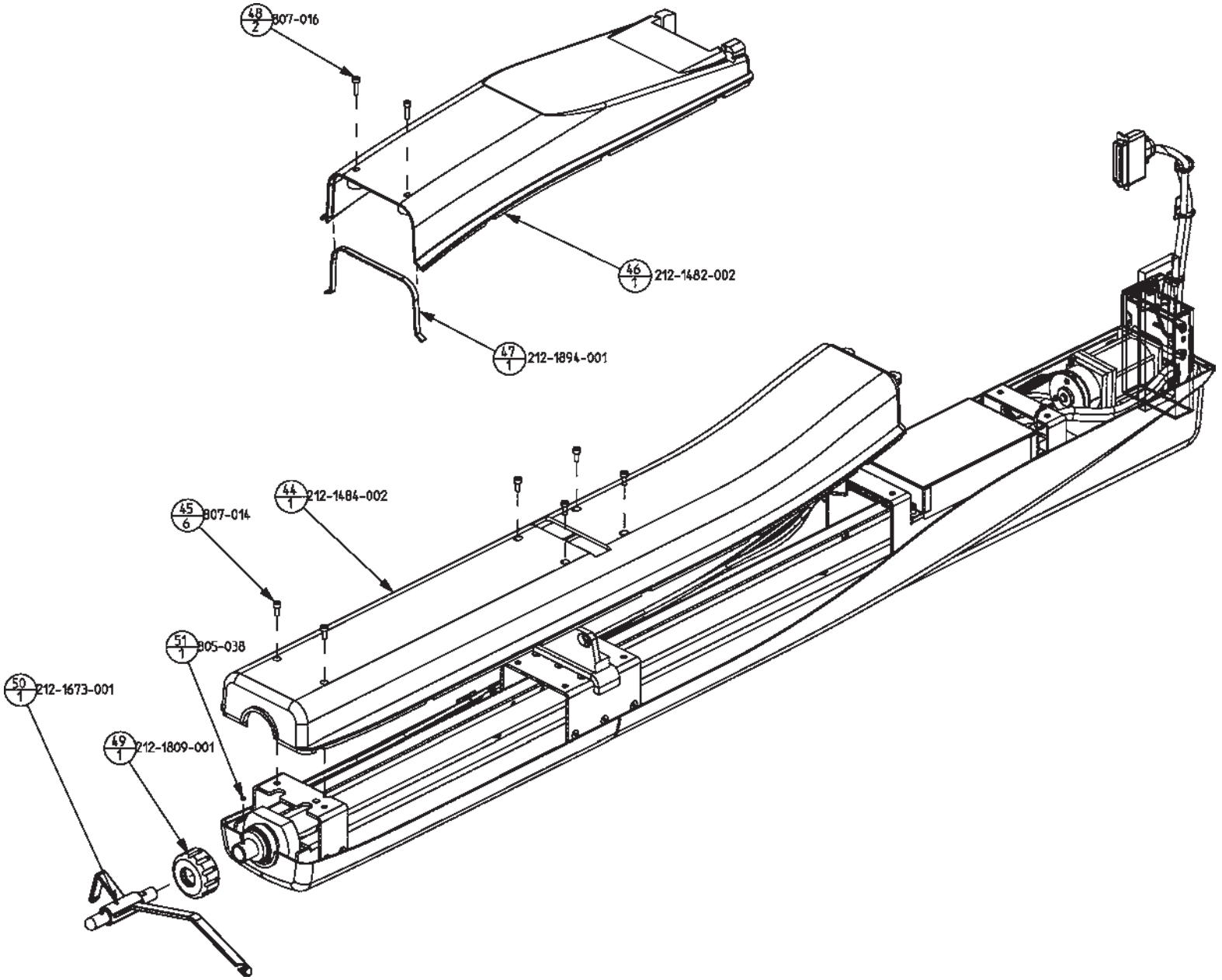
212-5004-501 **ASSY, IV POLE (6 of 9)**



212-5004-501 **ASSY, IV POLE (7 of 9)**



212-5004-501 **ASSY, IV POLE (8 of 9)**



212-5004-501 **ASSY, IV POLE (9 of 9)**

SECTION SEVEN
ADDITIONAL INFORMATION

UNPACKING AND INSTALLATION

BASE CONSOLE

1. Cut two nylon bands securing top cover and remove.
2. Remove accessories (6) from foam insert and set aside (see Figure 7-1).

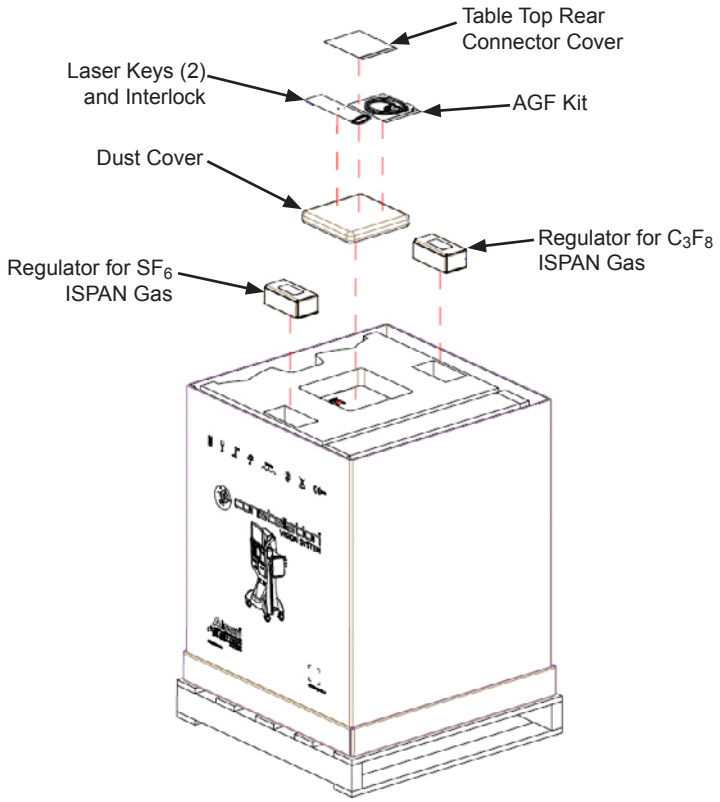


Figure 7-1. Base Console (Boxed) with Accessories

3. Remove accessory foam and wedge shaped foam and lift main box off the pallet.
4. Remove laser footswitch and illuminator lamp box from foam inserts on pallet.
5. Using at least two people, lift base console from foam packaging and pallet.
6. Remove all tape from front and rear of base console.
7. Install illuminator lamp into auxiliary illuminator.

WARNING!
Wear safety glasses when handling illuminator lamps.

CAUTION
Do not touch lamp with bare hands.

7.1 Eject auxiliary illuminator module.

7.2 Remove cover from the lamp assembly.

7.3 Install lamp into auxiliary illuminator module.

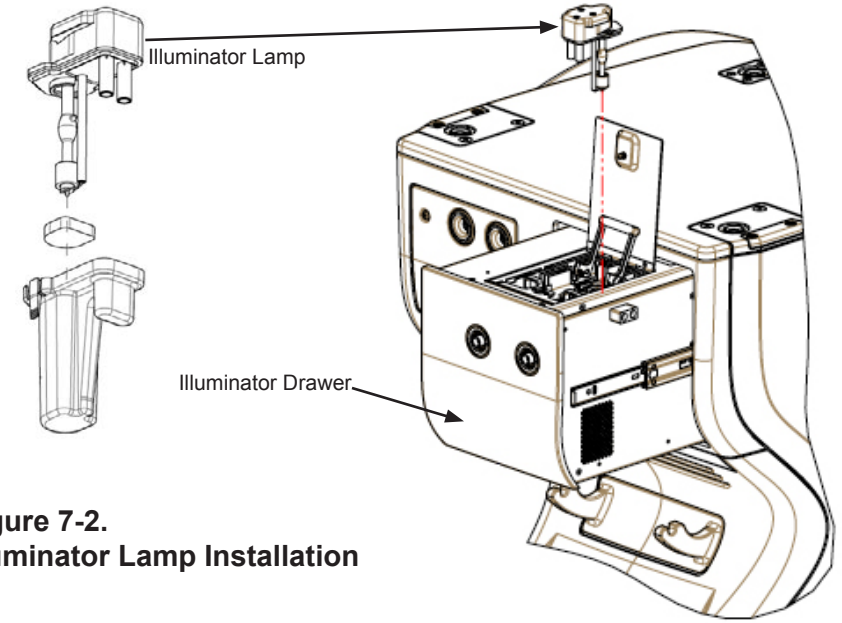


Figure 7-2.
Illuminator Lamp Installation

8. Remove cable grommet from top of base console and pull cabling into position to be connected to table top (see Figure 7-3).

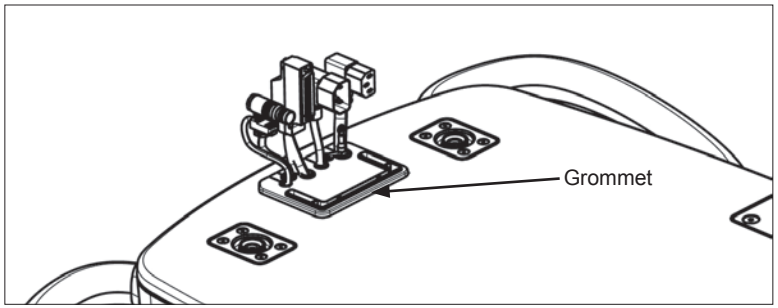


Figure 7-3. Grommet/Cabling from Base Console (shown with Table Top Installed)

TRAY ASSEMBLY

Note: The tray assembly can be installed on either side of the system; install per customer preference. Demo systems must have tray assembly installed on the left side (as you face the system). This procedure shows installation on the right side.

9. Remove the four ballasts and ballast tray from box.
10. Install two ballasts into tray using 6 mm hex bolts and partially slide ballast tray into guides in base console leaving enough room to install the remaining ballasts as shown in Figure 7-4. Install remaining ballasts.
11. Slide ballast tray into position and secure to base console using four 6 mm hex bolts and lock washers.

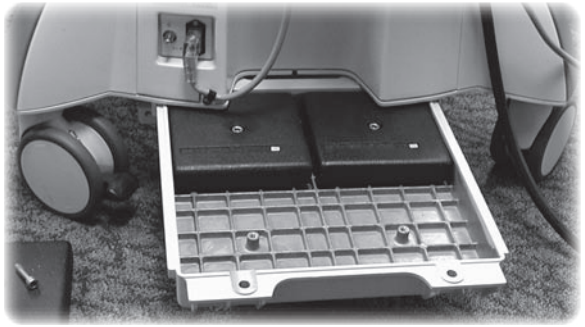


Figure 7-4. Ballast Installation

12 Remove tray arm assembly and tray tower from boxes.

13 Remove and discard bracket cover and two screws from side of base console (see Figure 7-5).

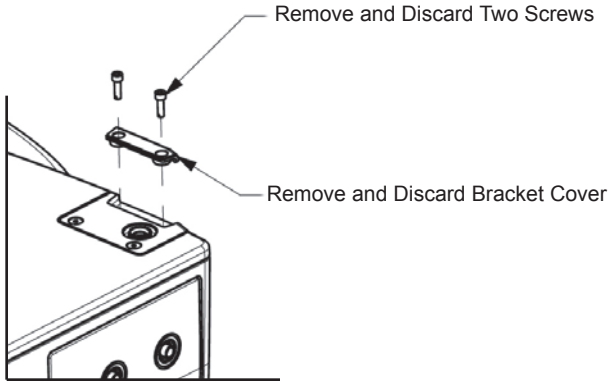


Figure 7-5. Bracket Removal

14 Attach upper part of tray arm tower to base console using two hex screws (see Figure 7-6).

15 Attach lower part of tray arm tower to base console using one hex screw and lock washer (see Figure 7-6).

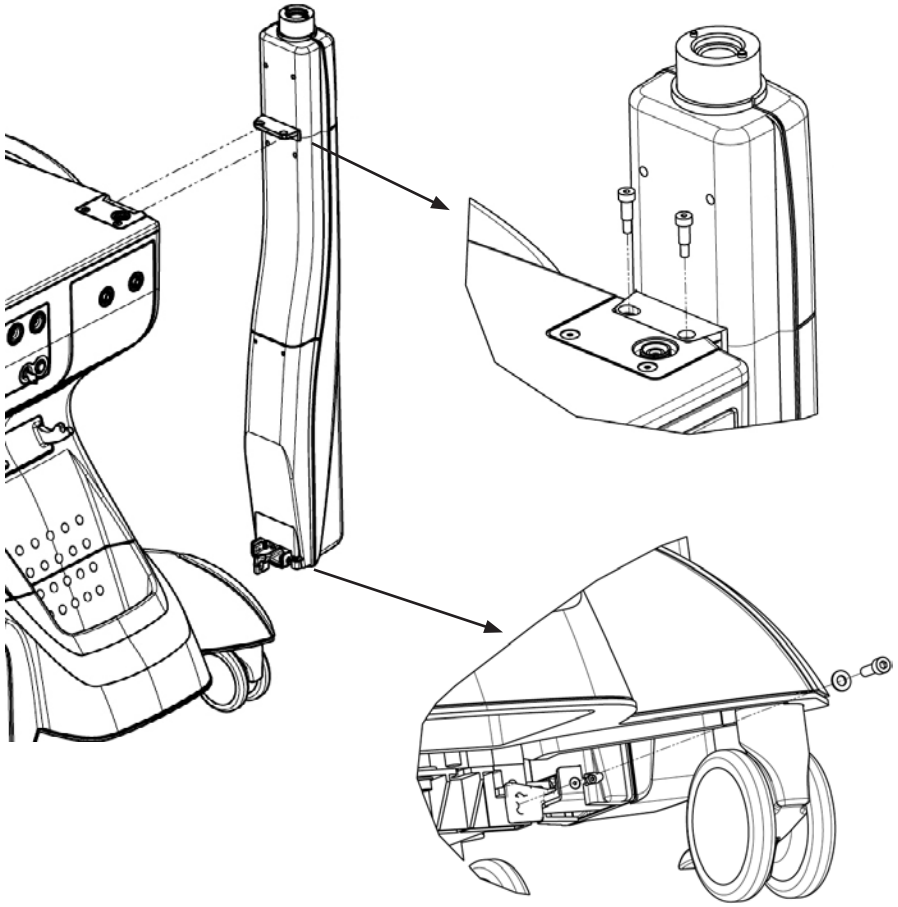


Figure 7-6. Tray Tower Installation

16 Refer to Fig 7-7. Remove skins from each side of the main tray arm joint (six 2.5 mm hex screws).

17 Loosen the 4 mm set screw on tray arm tower to allow tray arm joint to drop into place in tower.

18 Lower tray arm assembly onto tower so that holes on tray arm assembly fit into pins on tray arm tower.

19 Secure tray arm assembly to the tower using the 4 mm set screw.

20 Replace housing to each side of tray arm joint using six 2.5 mm hex screws.

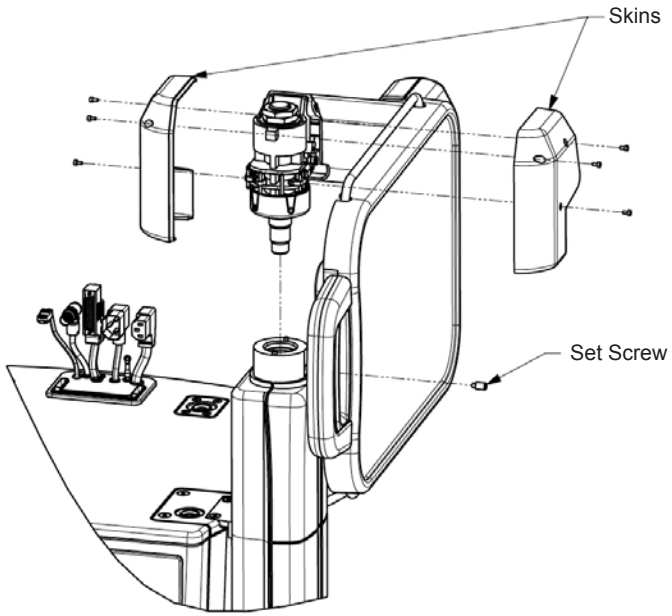


Fig 7-7. Attaching Tray Arm to Tray Tower

TABLE TOP

21. Cut two nylon bands securing top cover and remove.

22. Remove accessory bags and boxes from crate (see Figure 7-8).

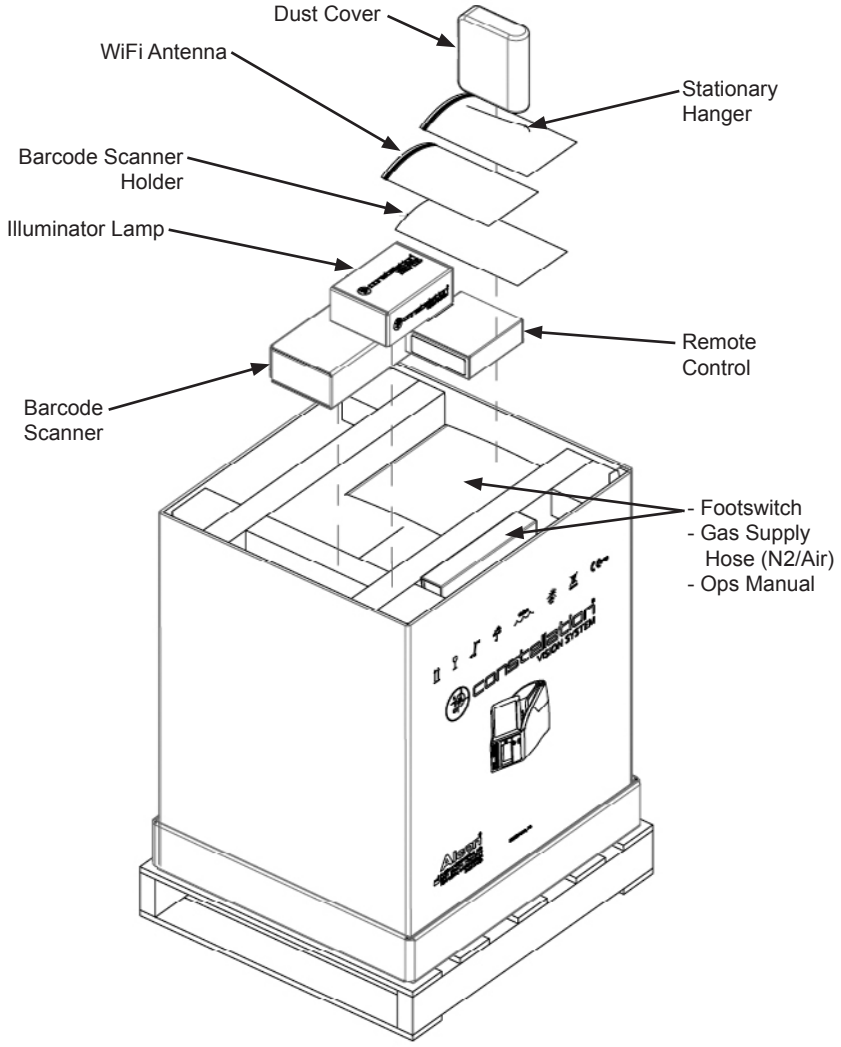


Figure 7-8. Table Top (Boxed) with Accessories

23. Remove foam inserts and lift main box off pallet.

24. Using at least two people, lift Table Top from pallet and place on base console as shown in Figure 7-9. Ensure that four bolts extending from bottom of table top go into four holes in top of base console.

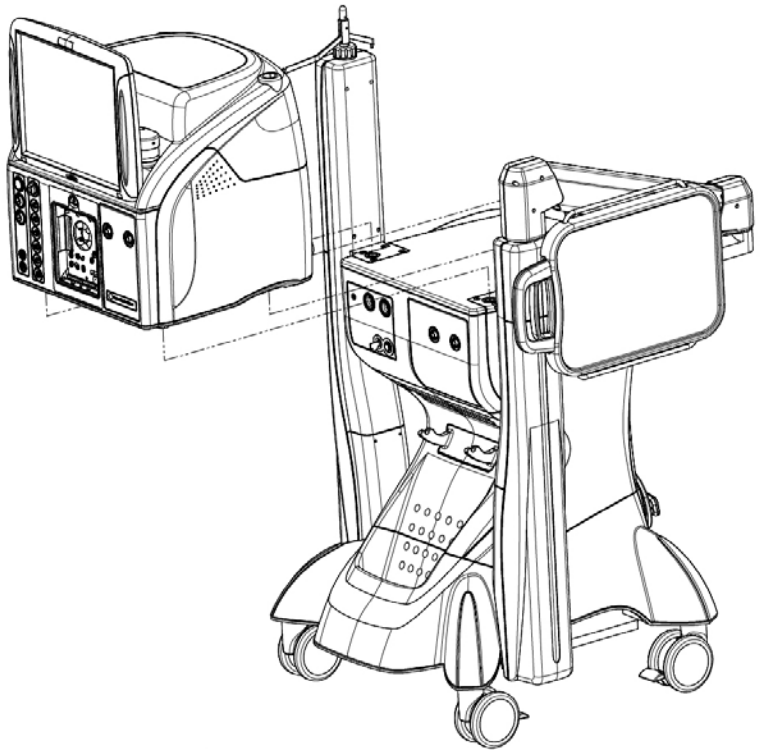


Figure 7-9. Table Top Placement on Base Console

25. Connect base console cables to table top as shown in Figure 7-10

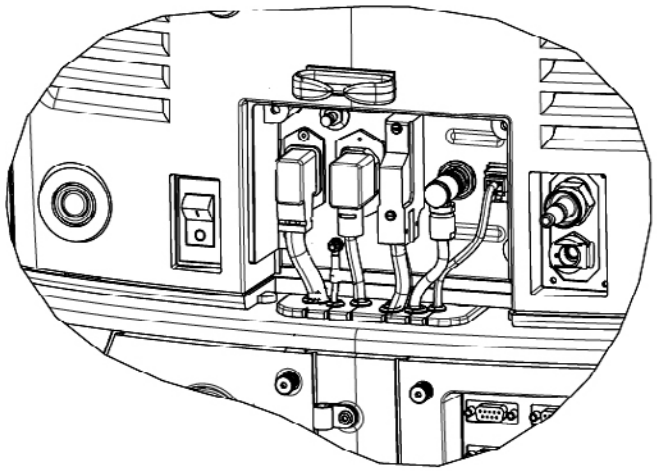


Figure 7-10. Table Top/Base Console Connections

26. Using the Table Top/Base Console Wrench, secure the table top to the base console by tightening the four bolts between the base and table top.

27. Attach cable cover (packaged with base console accessories) to rear of table top using two hex screws (see Figure 7-11).

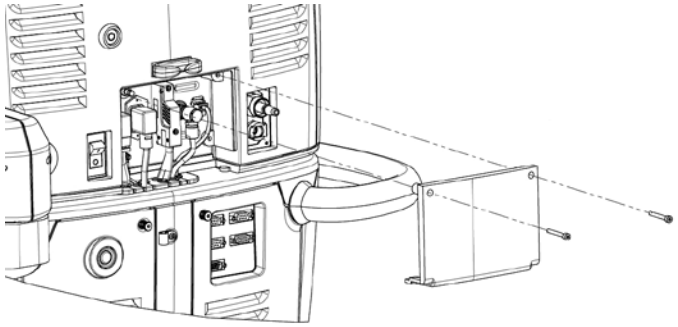


Figure 7-11. Rear Panel Connector Cover

28. Attach the stationary hangar and the barcode reader holder to the top cover (see Figure 7-12).

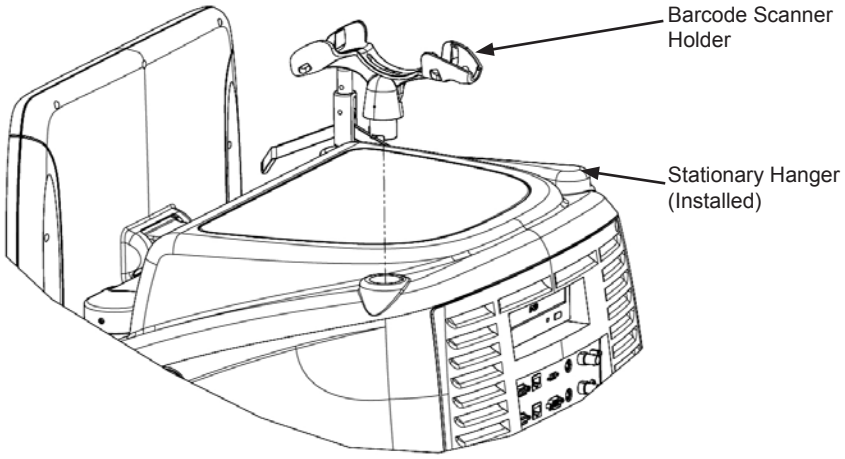


Figure 7-12. Installation of Barcode Scanner Holder and Stationary Hanger

29. Place the barcode reading in the holder and connect to the connector labeled with a barcode on the external connector panel.

30. Install illuminator lamp into table top illuminator (refer to auxiliary illuminator illustration in Figure 7-2).

WARNING!
Wear safety glasses when handling illuminator lamps.

CAUTION
Do not touch lamp with bare hands.

30.1 Eject table top illuminator module.

30.2 Remove cover from the lamp assembly.

30.3 Install lamp into auxiliary illuminator module.

31. Connect the *Constellation®* footswitch to the receptacle on the base console near the footswitch hangers.

32. Using the supplied pressure hose, connect the system to the preferred facility pressure source (see Figure 7-13). Additional fittings are supplied if required. Refer to the Maintenance section of this manual for instructions on changing the fittings.

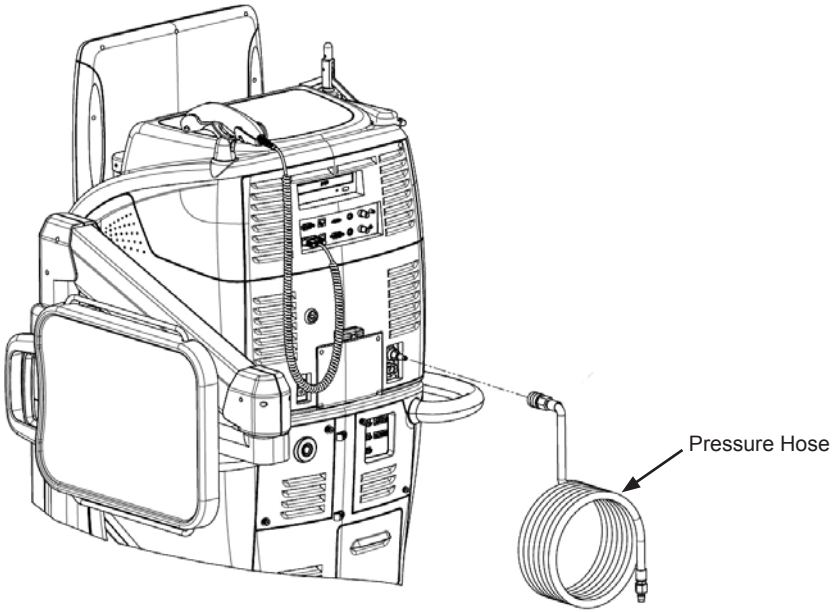


Figure 7-13. Pressure Hose Installation

33. Install ISPAN gas tubing as shown in Figure 7-14. Connect ends of tubing together. Place gas regulators into accessory drawer on rear of system.

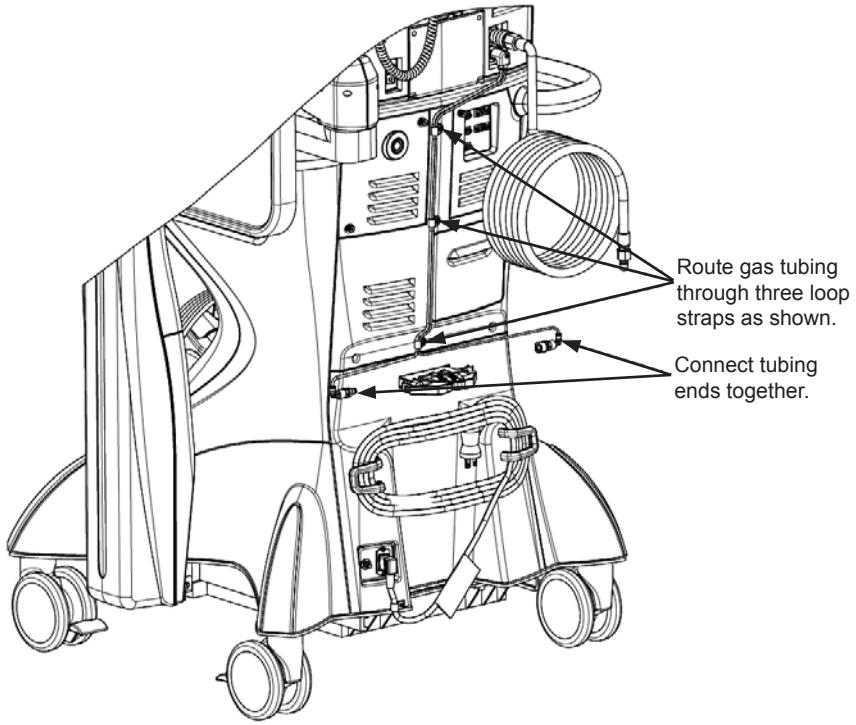


Figure 7-14. ISPAN Gas Tubing Installation